Physical Space, Void and Propagation of Electromagnetic Waves – A Hypothesis

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Abstract

This paper is based on the hypothesis that the physical space – which is commonly referred to as "the vacuum" – consists in a finite, continuous, fluid, incompressible and undetectable physical substance here labeled ***"the plenum"***. Therefore, in itself, *the plenum* does not consist of elementary component particles and is destitute of mass. The *plenum* is supposed to be made continuous and cohesive by an intrinsic *kinetic viscosity*, which – by definition – entails neither mass nor forces nor energy. The plenum is contained by an infinite ***absolute void*** in which – in absence of plenum – no physical phenomenon is possible. All possible physical phenomena constitute a *variety of states* of the plenum. (The plenum cannot be thought of as a kind of "ether").
A simple analysis of any possible oscillation of the plenum leads to conclude that the oscillatory motion is transmitted by transverse waves, whose propagation speed and frequency, along with the wave amplitude, decreases with the distance from the source wave. Besides, the analysis suggests that the wave propagation occurs by discrete "pulsating packets" of *semi-waves*, spaced by semi-wave intervals. These intrinsic characteristics of the transverse wave propagation are variously altered by the plenum's flux of the gravitational vortex in which the wave source is located, though the discontinuous nature of the transverse wave propagation remains preserved.
In addition to the foregoing deductions, there is also reason to conclude that transverse waves, whatever their nature and irrespective of the presence of shielding matter, can neither penetrate a gravity field beyond a fixed fraction of the distance between the waves' sources and the gravity field center, nor propagate across any gravitational field beyond a fixed distance from the center of the field.

1. *Basic hypotheses concerning the physical space*

In a book [1] and in papers of mine [2], [3], I have proposed to distinguish the *physical space* (*i.e.*, the space where all the physical phenomena of our universe are possible) from the *void*, the latter being viewed as an absolute infinite nothingness in which no physical phenomenon can either occur or be imagined. The *finite* physical space should be thought of as "included" in the infinite *void*. I have also suggested to assume that such a physical space, referred to as "*the plenum*", is a *continuous medium* deprived of mass (in a possible conceptual similarity – acceptable to people who believe that energy may not involve matter – with the physical consistence of photons) and kinetically endowed with the properties of fluids. In its possible *rest state* the "plenum" should also be considered as deprived of any form of energy, to the extent that not even a thermal state can be associated with that medium in the absence of any constituent particles.

The fact that a certain amount of matter and photon energy is spread throughout the *plenum* does not change the primitive physical nature of the latter, like the bubbles of gas contained in a bottle of mineral water do not change the nature of liquid proper to the water in the bottle.

In my opinion, it's of a crucial importance to assume that the *plenum* is a fluid medium which *does not* consist of component particles – or other "energy" components proposed by some in a more or less fuzzy manner. In this connection, a basic consideration is that whatever hypothesis of elementary components may be proposed for ordinary matter at its basic level, the *irreducible* elementary component hypothesized *must* consist in something that is both *physical* and *continuous*, by the definition itself of elementary particle of matter. Thus, any concept of "elementary particle" rests on an inevitable idea of continuity of the *substance* in which it consists. Unless one prefers to bypass the problem of defining what elementary particles consist in by assuming that these are *point-like* objects, *i. e.*, kind of matter without physical size, with all the relevant logical difficulties that can be expected, as it happens in the case of the point-like particles postulated by quantum theories. Therefore, I deem it simpler and more profitable – at theoretical level – to attribute the characteristic of full physical continuity to the consistence of the whole physical space itself, the plenum, which – in its rest state – is *intrinsically undetectable*, albeit it is thought – in its various *kinetic*

states – to be the basic *substance* and *cause* of every detectable physical phenomenon.

A major characteristic of perfectly continuous fluids is their incompressibility**:** Each point of the continuous substance belongs to a whole, so that there are no particles that can modify the reciprocal distances in consequence of alterations in the forces that bind them to each other.

A number of authors are particularly fond of the idea that the physical space has the structure of a lattice, in the untouchable conviction that no physical entity can be allowed for if it is not suitably quantized. For example (let alone the innumerable examples of theories that postulate physical spaces made of an amazing variety of infinitesimal pellets whose substance is unspecified), some assume that the physical space (the structure of the *vacuum*) consists in a lattice of quasi infinitesimal "rings" hooked to each other (without specifying the consistence of such rings or hooks [4], [5]); whereas others believe that the *vacuum* consists in a lattice made of minuscule *dipoles* [6] or of various kinds of fractals [7] or other 3-D geometrical grids (without specifying the *substance* of those components); and so on. It may be added that an *"exhaustive"* explanation for everything is associated with most of the *quantized spaces* mentioned above.

Instead, as far as I am concerned, I *do not* purport to be in condition to *explain everything* through the idea of the *continuous plenum* I have introduced. Nevertheless, the *plenum* I hypothesize is manageable enough to model both gravitational phenomena and propagation of electromagnetic waves, and also to provide a viable idea about how mass formation can be thought of. Concerning mass formation, in the works of mine mentioned above I discuss the hypothesis that matter and mass originate from the intrusion of *void* in the discontinuities (sort of "lacerations") created by torsion motions of the *plenum*. It seems impossible, for instance, to think of any point of a continuous fluid medium that spins without "lacerating" the continuity of the medium. Thus, detectable matter and mass result from combinations of motions of the plenum about nuclei of absolute nothingness (the *void*). In turn, such a kind of "combinations" generates detectable energy through their motions within the plenum.

2. *Transmission of motion through the plenum*

The hypothesized perfect continuity that characterrizes the substance of the fluid immaterial plenum requires answers to a few questions, such as, for instance, whether and how any point of the plenum can move with respect to all of the infinite remaining points of the same substance, given that the plenum can behave like a fluid.

A reasonable answer to this basic question is assuming that the distance traveled by any point of the plenum is necessarily associated with the motion of all the adjacent infinite points of the plenum, in such a way that *the sum* of the distances traveled by these infinite number of points equals the distance of the point that originates the motion. (It's obeying a principle dubbed "shift conservation" that – for massless fluids – is *somehow* the analogous of the "momentum conservation" that holds for any kind of material substance). This assumption implies that any point of the plenum cannot move without dragging along all the *adjacent* points of the fluid to which it belongs, as it is also of most material fluids. However, material fluids consist of distinct particles that interact with each other through systems of forces whose overall effect can be summarized by the concept of *dynamic viscosity*. This concept involves the existence and definition of masses, energies and forces, and cannot be adopted to describe the quite special "viscosity" of the fluid plenum, which – by hypothesis – does not consist of material components.

Nevertheless, physics uses also the concept of *kinetic viscosity*, which does not involve either masses or energies and *seems* therefore fit for describing the plenum's viscosity. In any fluid in motion kinetic viscosity is defined as follows:

$$[1] \qquad w = A\gamma \frac{dv}{dr}$$

in which w is the kinetic viscosity of the fluid, dv/dr is the gradient of the fluid's speed v with respect to the distance r from the motion origin**;** A represents any conventional surface unit and γ represents the *coefficient* of *kinetic viscosity* that is proper to the fluid considered. As to the relevant physical dimensions, it is

$$[2] \qquad [w] = [L^4 T^{-2}] \quad \text{and} \quad [\gamma] = [L^2 T^{-1}].$$

Let's now consider that any material particle in motion within the plenum puts into motion all the other points of the adjacent physical space, since the material particle is in itself consisting of points of plenum in motion. Let's in particular imagine that it's the motion of an electrical charge distributed on the surface of a cylindrical conductor, whose circular section radius is r_o. At any length s on the electrical conductor traveled by this charge corresponds a mobilized *cylindrical surface* of plenum defined by $2\pi r_o s$.

Allowing for the foregoing hypotheses and relevant implications, the infinite points of any generic co-axial cylindrical surface of the adjacent physical space are dragged to cover – for any s on the electrical conductor – an **equivalent** surface $2\pi r s_r = 2\pi r_o s$, where r denotes the orthogonal cross-section radius of the generic co-axial cylinder (cylindrical shell) and is also the distance from the axis of the electrical conductor. Thus, s_r is the length covered by the motion of each point of any generic co-axial cylindrical shell in correspondence with s, to write

$$[3] \qquad s_r = \frac{r_o}{r} s \,.$$

The time derivative of this equation gives the formula for the charge's motion speed

$$[4] \qquad \dot{s}_r = v_r = \frac{ds_r}{dt} = \frac{r_o}{r} \dot{s} \,.$$

Equations [3] and [4] do not take into account the effect of the kinetic viscosity that might characterize the plenum. The hypothesized viscosity does instead matter concerning the *transmission of the motion* from the motion origin to all the plenum shells that are co-axial with the motion line**:** This means that the motion transmission is *not* instantaneous, but takes place according to a *transmission speed* that is affected by the fluid's viscosity. As known, the motion of the electrical charge generates a magnetic field around the conductor, whose formation in the physical space delays according to the distance from the electrical current.

3. *Transverse waves*

According to physics, the motion transmission in incompressible fluids occurs by *transverse waves*, whatever the length of the waves. The motion *transmission speed* u can be expressed (remembering Equations [1] and [4]) by the following equation**:**

$$[5] \qquad u_r = \sqrt{\frac{w}{A}} = \sqrt{\gamma \frac{dv}{dr}} = \sqrt{\gamma \frac{\partial v_r}{\partial r}} \,,$$

which gives evidence to the fact that the *motion transmission* speed depends on the distance from the motion source.

Let's now imagine that the electrical charge in motion on the conductor inverts the direction of its motion periodically, with period T. In such a case, at any instant t of the motion the length traveled by the electrical charge and respective shell of plenum is expressed by

$$[6] \qquad s(t) = a\cos(\omega t - \varphi)$$

in which a is the maximum distance (amplitude) from the initial rest position traveled by the electrical charge, $\omega = \frac{2\pi}{T}$ is the frequency of the oscillatory motions and $\varphi = \frac{\pi}{2}$ is the oscillation phase (so that $s(0) = 0$ when $t = nT$, and $s = a$ when $t = nT/4$, $n = 0, 1, 2, \ldots$).

Together with the various lengths traveled by the co-axial shells of plenum, the velocity and amplitude of the plenum in motion does also vary with both time and distance from the motion origin, according to the following equations:

$$[7] \qquad \vec{v}_r = \left| \frac{\partial s_r(t)}{\partial t} \right\rangle = \left| -\frac{a r_o}{r} \omega \sin(\omega t - \varphi) \right\rangle$$

in which it can be put, as a definition,

$$[8] \qquad a_r = \frac{r_o}{r} a.$$

Accounting for Equation [3] after replacing s with a (*i. e.*, considering $s_{max} = a$), Equation [7] shows how the velocity vector of the oscillating points of plenum varies with time and with the distance from the oscillation origin, while Equation [8] shows that the oscillation amplitude, *i. e.*, the maximum length covered by the points of the plenum in the co-axial cylindrical shells, undergoes a progressive diminution as the distance from the oscillation origin increases**:** It is only the formal quantification of the logical consequence of the decreasing average oscillation velocity, which – even if the oscillation period T keeps constant – is inversely proportional to the distance from the oscillation origin. In simpler words, the relation [8] shows that the "intensity" of the wave declines inevitably with the distance from the source.

Velocity v_r expressed by Equation [7] shall now be derived with respect to r and replace $\partial v_r / \partial r$ under the square root of Equation [5], to obtain**:**

$$[9] \qquad u_r = \frac{1}{r} \sqrt{\gamma a r_o \omega \sin(\omega t - \varphi)}.$$

Therefore, not only is the wave transmission speed decreasing with the distance from the source of the

wave, but the transmission speed does also oscillate from speed zero to a maximum value which, at any distance r from the source, is expressed by

[10] $$^{\max}u_r = \frac{\sqrt{\gamma a \omega r_o}}{r}.$$

According to Equation [9], *the wave transmission is neither constant nor continuous*, since it occurs through *pulsations*: In particular, when $\sin(\omega t\text{-}\varphi) < 0$, the value of the transmission speed becomes imaginary (the transmission speed becomes virtual for a while). Should this be correct, there is to conclude that the wave transmission through the plenum takes place every other half oscillation period $T/2$, with an alternate half period of transmission interval.

As pointed out, Equations [3] to [9] regard the transmission of *transverse* waves across the plenum, for the substantial perfect continuity of this medium does not allow the formation of *longitudinal pressure waves*. According to the hypothesized properties of the plenum, this has no elasticity, whereas, due to its possibility to expand within the surrounding void (to regain the net volume subtracted by the intruded *void* that concurs to the creation of matter), the plenum shall be thought of as endowed at least with the particular *plasticity* of dense fluids. Therefore, displacement of plenum in motion along one and the same linear direction engaged by the motion source does not involve pressure waves, as the points of the medium aligned in the same line of motion have not to *drag* each other and they "slide" all together like a single "solid" piece: This kind of motion consists in a simultaneous shift of infinite aligned points of plenum, in a linear direction that is always orthogonal to the wave propagation direction and invariant with respect to any reference frame.

The oscillatory motion described by the foregoing equations is actually an interpretation of the otherwise conceived electromagnetic waves. One may assume that among the properties of the plenum there is also that the wave transmission speed can not exceed the *conventional* speed of light c, so that in the close proximity of the oscillatory current (where one may assume that $r = r_o$) the initial motion transmission speed is c, whence [9] can also be written as follows:

[11] $$c = u_{r_o} = \sqrt{\frac{\gamma a \omega}{r_o}},$$

whence also

[12] $$a\omega = \frac{2\pi a}{T} = \frac{r_o c^2}{\gamma}.$$

By substitution of factor $a\omega$ in [9] with [12], the expression of the wave transmission speed u_r can be written as

[13] $$u_r = \frac{r_o c}{r}\sqrt{\sin(\omega t - \varphi)}.$$

This equation is a general description of wave propagation across *plain* sections of the plenum. Should it be referred to the propagation of electromagnetic waves, one may account for the definition $c^2 = 1/\varepsilon_o\mu_o$, which expresses the wave's maximum speed in terms of the dielectric constant ε_o and the magnetic permeability μ_o, respectively, of the "vacuum" (*i.e., plenum)*, so that also

[13a] $$u_r = \frac{r_o}{r}\sqrt{\frac{\sin(\omega t - \varphi)}{\varepsilon_o \mu_o}}.$$

Consider now that the initial wave length λ is given by the ratio $\lambda = u_{r_o}/\omega$: It is then clear that the product $\lambda_r\omega_r = u_r$ cannot remain constant, as it decreases with u_r. Thus, it shall be concluded that either the wave length or the frequency or both decrease with the distance from the wave source, according to Equation [13]. But a decreasing wave transmission speed implies that the wave length increases necessarily, because of the "delaying" wave signal associated with the slowing u_r, as it happens per the *Doppler effect* when the observer is in a relative recession from the wave's source. Therefore, it is the wave frequency [3] that – in the case considered – shall correspondingly decrease to an amount that verifies the equation

[14] $$\omega_r = \frac{u_r}{\lambda_r}.$$

4. *A first set of conclusions*

Under the hypothesis that the physical space consists in a finite continuous, incompressible and undetectable substance and that such a substance (the *plenum*), though destitute of mass, is made cohesive by an intrinsic kinetic viscosity, a simple analysis leads to conclude that any possible oscillation of the plenum transmits its oscillatory motion through transverse waves, whose propagation speed and frequency, along with the wave amplitude, decreases with the distance from the source wave. Looking at Equation [13], the reduction of the propagation speed - as the

distance from the wave source increases - should be remarkable.

The foregoing considerations may in particular be referred to the propagation of electromagnetic waves.

The conclusions of this analysis contradict current well established assumptions, according to which – for instance – the speed of the light's propagation is constant, and no change intervenes in the wave frequency during the light's travel across a uniform and homogeneous physical space.

Besides, this analysis suggests that the wave propagation occurs by discontinuous "pulsating packets" of *semi-waves*, spaced by semi-wave intervals*:* Which may be viewed as a particular description or interpretation of the *quanta* of radiation allowed for by current theories of physics. As to the formation of "photons" endowed with mass/energy, the relevant hypothesis is formulated and discussed - within this theoretical framework - in the referenced book of mine[1], pp. 43-54. In very few words, the hypothesis suggests that at the plenum's points represented by the "spikes" of the oscillation – where the oscillating line of motion inverts it direction – there is the instantaneous formation of ephemeral vortices due to the torsion stress undergone by the medium, where points of the plenum are compelled to spin, with a local intrusion and disappearance of nuclei of *void* (*i. e.*, of *absolute nothingness)*, which determine the local ephemeral formation of masses and energy.

5. ***A necessary additional analysis***

The foregoing analysis regards any source of wave that is isolated in the cosmic space and is neither affected by gravitational fields nor disturbed by other sources of waves. Considering that any source of waves is normally located within a gravitational field, it is necessary to account for the interference exerted - on the wave propagation - by the plenum's flux of the relevant gravitational vortex.

The oscillation path of the transverse wave is crossed by the parallel lines of the vortex flux in every point of each wave propagation line. Therefore, in every point of every wave propagation line there is to account for the composition of two velocity vectors, one of which represents the local stationary velocity of the vortex flux, while the other represents the wave's oscillating velocity vector, whose intensity and direction varies periodically. (Refer to the **Figure 1** beside).

In general, it may clearly be assumed that in each point of the wave propagation the lines of the vortex velocity vectors are co-planar with the wave's local oscillation velocity vectors, so that the resultant of the vector composition is in each point a vector whose ***module*** is given by the projection - on the line of the *oscillation velocity* vector - of the module of the *vortex velocity* vector summed with the module of the former.

As shown in reference [1], pp. 83-84, the speed of the flux threads of a gravitational vortex depends on the distance from the center of the vortex core, according to the following equation:

[15] $$V = \frac{H}{R}$$

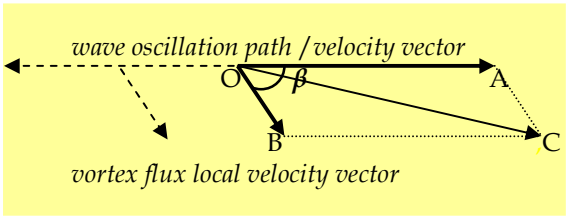
where H is a constant proper to the particular gravitational vortex and R is the distance from the center of the vortex core. (The physical dimension of this constant is $[H] = [L^2T^{-1}]$).

If l is the distance of the regarded wave source from the core of the gravitational field in which the source is located, then – allowing for Equations [7] and 12] - the ***module*** of the resulting oscillating velocity of the plenum involved by the transverse wave is expressed by

[16] $$V_r^* = v_r + \frac{\vartheta H}{l+\delta r} = -\frac{r_o^2 c^2}{\gamma r}\sin(\omega t - \varphi) + \frac{\vartheta H}{R},$$

in which ϑ is the cosine of the angle β, as per Figure1 below, $l+\delta r = R$ is the distance of the wave considered from the center of the gravitation field, δ is the cosine ($-1 \leqq \delta \leqq +1$) of the angle μ that r forms with l (refer to Figure 2 below), and - as seen - c is the alleged maximum propagation speed of a wave through the plenum. This maximum propagation speed is supposed to be always associated with the wave origin.

Figure 1



$$\overline{OC} = \overline{OB}\cos\beta + \overline{OA}$$

$$\downarrow \vartheta = \cos\beta$$

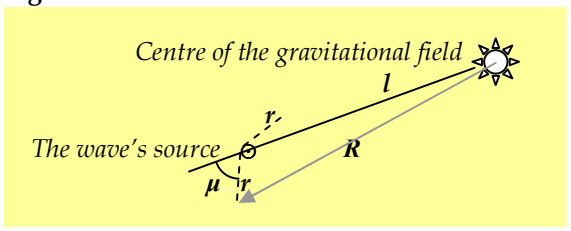
$$\overline{OC} = \frac{H\vartheta}{l+\delta r} + \overline{OA}$$

$$\overrightarrow{OA} = \vec{v}_r = \left| -\frac{a\omega r_o}{r}\sin(\omega t - \varphi \right\rangle$$

The influence of the cosine factor ϑ, whose value may vary within the interval $0 \leq \vartheta \leq 1$, decreases as the angle β approaches $\pi/2$: When *the thread* of the

gravitational vortex flow is orthogonal to the wave oscillation path the gravitational field does not affect the wave's *propagation* velocity; whereas the gravitational vortex exerts its maximum influence on the transverse wave if the direction of the wave oscillation path coincides with the direction of the velocity of the vortex thread.

Figure 2



Therefore, remembering Equation [5], which defines the transverse wave's ***propagation speed,*** this - as modified by the interference of a gravitational field - is now expressed by

$$u_r^* = \sqrt{\gamma \frac{\partial V_r^*}{\partial r}} = \sqrt{\frac{r_o^2 c^2}{r^2}\sin(\omega t - \varphi) - \frac{\gamma H \vartheta}{(l+\delta r)^2}} =$$

[17]
$$= \frac{1}{r(l+\delta r)}\sqrt{r_o^2 c^2 (l+\delta r)^2 \sin(\omega t - \varphi) - r^2 \gamma H \vartheta} =$$

$$= \frac{\sqrt{\Delta_r}}{r(l+\delta r)} = \frac{\sqrt{\Delta_r}}{rR};$$

in which it is obviously

[18] $$\Delta_r = r_o^2 c^2 (l+\delta r)^2 \sin(\omega t - \varphi) - r^2 \gamma H \vartheta \gtrless 0 \ .$$

Thus, Equation [17] confirms the *discrete* and *pulsating* nature of the wave transmission as well as its declining speed and frequency also within a gravitational field; this concurs in slowing down the wave**. In general,** for any factor $\vartheta > 0$, the greater the strength H of the gravitational field, the greater its *braking effect* on the transverse wave's propagation speed.

For the sake of simplicity, let's now consider that particular case in which the wave's oscillation path is parallel to the direction of the flow threads of the gravitational vortex, *i.e.*, when the *propagation speed* is maximum: The wave follows the direction of the straight line (l of Figure 2) that passes through both the wave's source and the center of the gravitational field (*i.e.*, it's $\vartheta = 1$), the wave being either receding-from or approaching the gravitational center ($\delta = \pm 1$). If receding (*i.e.*, increasing r and $\delta = +1$), the decreasing wave transmission speed implies a lowering of the wave frequency; whereas in approaching the gravitational center (decreasing r and $\delta = -1$) the increasing transmission speed implies an increasing frequency of the wave**.** Both the effects lead the analysis back to cases known as *Doppler effect*. A number of experiences, carried out in the past years *within the Earth's gravity field*, have in fact ascertained and measured these particular effects of the gravity field on the propagation of light, albeit interpreted according to different views or theories. [8], [9], [10]

Besides, Equation [17] along with Figure 1 give a clear indication of how gravitational fields deviate the propagation line of transverse waves, considering that the wave *propagation route* is constantly *orthogonal* to the wave *oscillation path* (in Figure 1, the resulting oscillation path is along the straight line that includes the segment $\overline{OC}$). In this connection, it is also worth considering that the speed of light becomes – on average – of many orders of magnitude higher than the speeds of gravitational threads of plenum, as soon as the distance from the gravitational sources achieves cosmic scales. So that the length of *velocity arrows* like the $\overline{OB}$ in Figure 1 may appear negligible if compared to the *oscillation velocities arrows* like the $\overrightarrow{OC}$ shown in the same Figure.

Different situation intervenes when the light's transverse waves have to travel across huge cosmic distances and many different gravitational fields, with possible decelerations alternate with accelerations undergone also according to sequences of changes in the direction of the wave propagation.

[In an attempt to understand such a rather complex sequence of events, it seems appropriate remarking that, within the theoretical framework I have outlined in my book (refer to [1], pp. 88-101), the effect of a gravitational field in Equation [17] is introduced by a quantity that is dimensionally compatible-with and likely function-of the quantity that identifies the local *potential* of the same gravitational field. It is a way to point out a direct relation of proportionality between the two quantities, so as to write (scaling factor omitted)

[19] $$\frac{\gamma H \vartheta}{R^2} \propto \left(Q_{(R,\alpha)} = \frac{H^2 g_\alpha}{R^2} \right),$$

where $Q_{(R,\alpha)}$ is the local gravitational potential, whose merely numerical factor g_α represents a trigonometric function related to the latitude position of the point considered (in simpler terms, it's $\gamma H \propto H^2$).

As already observed by others **[11]**, the deflection of electromagnetic waves by the interference of gravitational fields may be viewed as due to the variation in the intensity of the gravitational potentials involved, by an effect analogous to the changes in the wave speed and frequency

of the light that propagates through a sequence of materials of different densities (such as, *e.g.*, from air into water, glass, etc.).]

6. *An aspect to clarify*

As already seen, the introduction of the hypothesis of wave propagation through a viscous medium leads to the description of transverse waves whose transmission speed varies not only with the distance from the wave source but also with the time elapsed from the instant of the wave generation. The sine function in Equations [13] and [17] implies *pulsation* of the wave and temporary suspensions of the propagation pulse. The actual travel speed of the wave, the one which matters albeit discontinuous, is – at any distance r – fixed by $\sin(\omega t\text{-}\varphi) = 1$. Allowing for this case, we can analyze the meaning of a *possible* complete stop of the wave transmission positing $\Delta_r = 0$ **:** This means looking for any condition (if any) of *impossible wave transmission* expressed by ${}^{\max}u_r^* = 0$, *i.e.*, positing (after obvious algebraic manipulations on [17]),

$$[20] \qquad \Delta_r^{'} = \left(\frac{\gamma H \vartheta}{r_o^2 c^2}\right) r^2 - (l + \delta r)^2 = 0 .$$

It's a second degree equation, which may be seen as concerning either the unknown r or the unknown l.

Let's now consider a particular case of wave source location. One may suppose that the origin of the wave is located at the surface of a star, where a charged particle of the star oscillates, thus generating electromagnetic waves. Because of its physical state, and particularly with reference to the electrical charge that vibrates on its surface, the star may be thought of as a natural spontaneously active electrical conductor subject to an alternate one-charge electrical current. Then the cross section of the "conductor" may conventionally be made coincide with that of the star, whose radius is R.

Accounting for the obvious assumption $\vartheta = 1$ and $\delta = \pm 1$, the radius R of the star is one and the same as the r_o shown by the preceding equations. Therefore, also the distance l of the wave origin from the center of the gravitational field coincides with R, so that **-** in this particular case - one can write

$$[21] \qquad r_o = l = R,$$

and replace r_o and l, with R in Equation [20]. Thus, considering only the wave propagation along the straight line direction that includes both the star's center and the location of the wave source, Equation [20] becomes

$$[22] \qquad \left(\frac{\gamma H}{R^2 c^2}\right) r^2 - (R \pm r)^2 = 0 ,$$

whose solutions are of an immediate determination.

For $\delta = +1$ (transverse waves receding from the star), one obtains

$$[23] \qquad \left(\frac{\sqrt{\gamma H}}{Rc}\right) r_1 = R + r_1 \Rightarrow \left(\frac{\sqrt{\gamma H}}{Rc} - 1\right) r_1 = R ,$$

whence

$$[23a] \qquad r_1 = \frac{R^2 c}{\sqrt{\gamma H} - Rc} .$$

The meaning of this result is clear: The plenum's viscosity puts a limit to the distance that a transverse wave can reach within the gravitational field of the star that generates the wave. The attainable limit-distance depends, for any wave-source, on the plenum's viscosity coefficient and on the strength H of the gravitational field, on which – almost obviously – the size R of the star also depends.

The only possible logical alternative (still for $\delta = +1$) is here to assume that ${}^{\max}u_r^* \to 0$ when $r_1 \to \infty$**,** which means that in Equation [23a] the quantity $\sqrt{\gamma H} - Rc \to 0$**.** This would imply that the found solution makes sense assuming that

$$[24] \qquad \sqrt{\gamma H} \approx Rc .$$

The other solution to Equation [22], obtained by use of $\delta = -1$ (concerning the wave propagation toward the center of the gravitational field), is given by

$$[26] \qquad r_2 = \frac{R^2 c}{\sqrt{\gamma H} + Rc} .$$

Should one take the deduction [24] above into account, solution [26] would lead to the following conclusion**:**

$$[27] \qquad r_2 \approx \frac{R}{2} .$$

This rather surprising result means that transverse waves propagating from the star's surface toward the star's core stop their travel at approximately half the distance to the star's centre.

However, Equation [26] fixes a limit to the inward wave propagation irrespective of the acceptability of the conclusion [24]. In fact, it can immediately be seen that it is in all cases

$$[28] \qquad r_2 < R .$$

This should necessarily mean also that no wave propagation is possible from behind that limit towards the star's surface and the external cosmic space**:** The limit is at a distance $R_o = R - r_2$ from the centre of the star. More precisely:

[29] $$R_o = \frac{R\sqrt{\gamma H}}{Rc + \sqrt{\gamma H}},$$

or

[29a] $$\frac{R}{R_0} = 1 + \frac{Rc}{\sqrt{\gamma H}}.$$

A possible interpretation of such a conclusion leads to the theoretical implications relevant to the structure and the fluid-kinematics inherent in a gravitational vortex of plenum [13]. In short, the theory hypothesizes that the "engine" that generates a gravitational vortex consists in a "ring-vortex" of fluid physical space (the plenum) that forms around a ring-core of absolute "void". The whirling motion of the plenum around the ring-core of void propagates through the physical space according to the law of decreasing velocities expressed by $V_r = H/r$, in which r is any distance from the vortex core, and $H = nV_C$ is a constant – proper to each vortex – that is defined by the product of the core's radius n with the vortex origin velocity V_C (of the plenum around the void). According to a *tentative* estimate initially based on the assumption that the light's velocity c is constant – V_C should in general exceed more than twice the speed of light. Therefore, there should exist in the vortex a distance R_o from the core at which the plenum flows at the maximum speed of light**:** It would just be the distance (the barrier) at which the propagation of light (whatever its speed) can not penetrate the vortex field further, nor can any transverse wave of light propagate starting from that barrier outwards.

Then, going back to the outer limit r_1 fixed by Equation [23a] to the light's propagation, it's worth considering that the only way to make it physically significant is assuming

[30] $$\sqrt{\gamma H} - Rc > 0 .$$

Such an obvious assumption can usefully be formalized positing

[31] $$\sqrt{\gamma H} = \psi Rc ,$$

in which the coefficient of proportionality ψ (whose value depends on the gravitational field considered) is a positive dimensionless quantity greater than 1, *i.e.*

[32] $$\psi > 1 .$$

Using [31], Equation [23a] becomes

[23b] $$r_1 = \frac{R}{\psi - 1};$$

while Equations [28] and [29] become

[28a] $$R_o = \frac{\psi R}{1 + \psi}$$

and

[29a] $$\frac{R}{R_o} = 1 + \psi^{-1},$$

respectively. Clearly, because of its definition (given by [31]), parameter ψ depends strictly on the size R of the star and the strength H of the relevant gravitational vortex. For example, as to the Sun, according to a rough estimate of mine, it may be $\psi \sim 1+(5\div6)\text{x}10^{-18}$.

As to the plenum's coefficient γ of kinetic viscosity, considering that $\psi > 1$, one can deduce that

[33] $$\gamma > \frac{R^2 c^2}{H} .$$

For example, with reference to the solar sphere and to the relative gravitational vortex whose "strength", H_S , I have tentatively (and questionably) estimated in reference[1] ($H_S \approx 6.03765\text{x}10^{13}\ \text{m}^2/\text{sec}$), it is possible to see that the coefficient of kinetic viscosity of the plenum should be *greater* than the quantity shown below:

[34] $$\gamma > \frac{(R_S c)^2}{H_S} = \frac{(6.965\times10^8 \times 2.99792\times10^8)^2}{6.03765\times10^{13}} = 7.22135\times10^{20}\ \text{m}^2/\text{sec}$$

This substantially means that the plenum's viscosity is at any rate expected *very far* from being negligible.

In this connection, it seems worth mentioning a quite recent paper published by academic researchers who, through an orthodox reasoning dressed in a rather smart *quantum language* (perhaps to overcome an irreducible shyness), suggest that the physical space might be a special *super-fluid* substance, which could consist in a lattice-like structure that may be thought of as existing at a cosmic scale lower than Planck's (which means "actually undetectable") [14]. One characteristic of such a super-fluid should be an *extremely weak* viscosity, *otherwise* photons could not travel the unbelievable distances we imagine. Theses of this kind do not leave many hopes to any near possibility of radical changes in the main-stream philosophy.

7. *Conclusions*

The foregoing analysis is a theoretical exercise that shall be viewed as a due appendix to the theory I have expounded in my book on gravitation [1].

The substance of the analysis draws attention to the possibility of a different approach to cosmological studies, by means of a model that is much simpler than the mainstream hyper-complicated theories and hypotheses that persist in the vain attempt to adjust themselves to observational data, which instead - day by day - belie them systematically. Since decades, it's evident that scientists should no more think and operate wearing only the "collar" of Relativity and/or quantum physics.

Concerning the propagation of electromagnetic waves across the physical space, this paper drafts some ideas that purport to be a little less naïve than the image of huge unceasing caravans of luminous particles (the photons) traveling (like wonderful swarms of fireflies) billion years and many billion parsecs at a constant speed and without encountering any significant disturbance. What is here suggested is that the physical consistence of the cosmic space and the existence of so many myriads of gravitational fields may heavily affect the propagation of waves. Far from rejecting the fact that the formation of photons (or the like) is associated with the propagation of the trans-verse electromagnetic waves, the idea suggested as to these ephemeral particles is that they are borne and die periodically, flashing and vanishing where they appear**:** It's not their journey, but it's their formation process that moves and propagates through the cosmic space.

Such a process has everywhere to combine with the omnipresent activity of gravitational fields.

Gravitation is a riddle that opposes a dramatic resistance against all attacks from orthodox clerks, in spite of their "ropedancer" mathematical abilities. It is an amazing fact indeed that most of them, including top level scientists, are not able to get rid of the mythical belief for which gravitation "is the property of masses to attract each other", notwithstanding Newton himself rejected and criticized such a hypothesis and Einstein suggested that gravity and gravitation have most likely nothing to do with any exchange of infinitesimal interaction-pellets shot by material particles against one another; and, above all, notwithstanding the evident impossibility of catching "gravitons", be it at least one; whereas we should hypothetically live fully immersed in an immense and *extremely dense* ocean of gravitons, whatever physicists think of gravitons. Almost all of the professional as well as dilettante physicists, astronomers and cosmologists are bound by their inability to renounce *quantization paradigms*, up to trying several theoretical plots to quantize *even* the space-time of the General Relativity**;** it may paradoxical, but it's true.

There is a worrying conceptual confusion, which depends on the refusal to distinguish the role of effective operational "manuals" (quantum methodologies in particular) from the conditioning and misleading conviction that the *manuals* are also intended to provide the *Final Truth*.

Each different area of scientific research requires specific appropriate conceptual instruments, basing on the practical and profitable principle that new simpler instruments are often much more effective than well-tested complicated instruments that can succeed in other different fields of research.

The analysis expounded in this paper shows a few implications of the hypothesis that the physical space is an undetectable *continuous* fluid substance – dubbed *the plenum* - from which all physical phenomena are born and within which they can interact and propagate. "The plenum" is assumed to be the "mass-less quintessence" in which the universe consists.

Assuming also that this "quintessence" is endowed with its own *kinetic viscosity*, there is stuff to deduce that the speed of light cannot propagate at a constant speed, and even that light and radiation have intrinsically limited range of action, also because of the effects of the gravitational fields in which the propagation of light and radiation takes place.

The main aim of this paper is to suggest – indirectly and through a mere philosophical reasoning – new methods and tests, with no pretense to provide any one with "truths" about the world. I deem it is absolutely vain – in the best case – to formulate "explanations" that cannot be practically tested and used in view of further technological achievements.

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