Declining Speed and Frequency in Waves Crossing the Cosmic Space

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Upon the basic assumption that the universe's physical space consists in an undetectable continuous and incompressible fluid, it is found that the propagation, through such a medium, of transverse waves - like gravitational standing waves or electromagnetic waves - entails loss in the wave frequency and propagation speed as the distance from the waves' source increases. It is a conclusion that derives from the hypothesis that the fluid cosmic space (which is here dubbed "the plenum" and thought of as destitute of mass) is kept cohesive by its own *kinetic viscosity*, in place of an impossible *dynamic viscosity.* Thus, the hypothesis leads to question the postulated constancy of the speed of light.

1. Structure of Gravitational Vortices and Alleged Viscosity of Cosmic Space

In a previous paper of mine [1], only basic hypotheses were formulated about the characteristics of the finite *physical space* of the universe, which I have dubbed "the plenum" in opposition to the *absolute void* (or *true vacuum*), the main purpose being there to get soon at the point concerning gravitation.

Motions of the plenum and relevant propagation through the plenum were analysed without accounting for any possible viscosity of the medium, upon the fundamental hypothesis that this quite special fluid does not possess mass.

In physics, viscosity - and more precisely *dynamic viscosity* - is usually defined as a force, according to the following formula

$$w_d = \eta A \frac{dv}{dr} \tag{1}$$

in which w_d is the *force* (an internal friction) exerted by the fluid's dynamic viscosity, A is the contact unit-area of two adjacent layers subjected to the viscosity (the friction due to the difference in the relative motion speeds); v is the fluid's speed that varies with distance r from the origin of the fluid's motion, and η is the *coefficient* of *dynamic viscosity*, whose physical dimension is $\left[\eta\right]=\left[ML^{-1}T^{-1}\right]$. This coefficient is a constant characteristic of the fluid. Therefore, the *dynamic tension* existing between two adjacent layers of fluid in relative laminar motion is given by

$$\tau_d = \frac{w_d}{A} = \eta \frac{dv}{dr}\,. \tag{1'}$$

Physics defines also a *kinetic viscosity,* which involves neither mass nor force and can be obtained from Eq. (1) after division by the fluid's density δ, to write

$$w = \frac{w_d}{\delta} = A\gamma \frac{dv}{dr} \tag{2}$$

whose physical dimension is $\left[\omega\right]=\left[L^4T^{-2}\right]$, and where constant $\gamma = \eta/\delta$ represents the *coefficient of kinetic viscosity* of the fluid (the constant's physical dimension is $\left[\gamma\right]=\left[L^2T^{-1}\right]$.

Thus, it is assumed there is also a *kinetic tension* expressed by

$$\tau = \frac{w}{A} = \gamma \frac{dv}{dr}\,, \tag{2'}$$

which acts between two adjacent fluid layers in relative laminar motion.

This definition of *kinetic viscosity* may be used to express the degree of kinetic cohesiveness that binds any layer of plenum in motion to the adjacent layers of fluid. It is an option based on the consideration that no concept of "mass" is necessary in defining and addressing the plenum's viscosity.

Upon the assumption that the *coefficient* of *kinetic viscosity* is a constant value that characterises the fluid plenum, Eqs. (2) and (2′) show that the strength of both *kinetic viscosity* ω and *kinetic tension* τ decline with the speed of a vortex stream.

Let's analyse the implications of the given definition of viscosity relevant to the plenum's motion that characterises the ring/spherical vortex described in precedent paper [1]. With reference to Fig. 1 of that paper, it's useful to add some lexical terms for better identifying distinct sections of the inner part of a spherical vortex.

The graph (here below reproduced in a smaller scale) represents a polar cross section of a spherical vortex, as it originates when a ring-vortex is immersed in a stream of plenum that flows parallel to the axis of the vortex ring. The two round black spots represent a cross-section of the vacuum core (*true vacuum,* or *void*, i.e., absence of plenum) of the ring-vortex, while the central smaller round spot is a symbolic image of the *void nucleus* of the vortex generated by the inner speediest rotation of the ring-vortex fluid. One can conventionally define "*core*" of the vortex the sphere whose diameter is 2*R*, which is the *external* diameter of the ring of *void* that forms the "spine structure" of the ring-vortex.

With reference to the centre of a gravitational vortex, the speed distribution of the fluid's stream through the plenum was previously [1] expressed by $v = VR/r$, where V is the plenum's speed at the core's surface, R is the core's radius, and r is the distance from the vortex centre.

However, allowing for the inner structure of the spherical vortex illustrated above, the plenum's speed distribution previously described by v must be viewed as a simplification.

Actually, the plenum's speed distribution in a spherical vortex should more correctly be represented by the following formula:

$$v = \frac{V r_0}{r - (R - r_0)}, \tag{3}$$

considering that the *source* of the fluid motion is at the surface of the "*void doughnut* ", whose circular cross-section radius is here denoted by r_0; this is obviously *smaller* than R.

The reason for the simplification previously adopted in the reference essay is quite reasonable, since the extent of both R and r_0 is negligible in determining the vortex gravitational field, when R (let alone r_0) is compared to the gravitational distances that were usually involved by the analysis.

Nevertheless, in addressing the definition of the kinetic viscosity of the plenum, R and r_0 are no more negligible. By use of Eq. (3), the derivative of speed v with respect to distance r from the vortex centre is

$$\frac{dv}{dr} = -\frac{V r_0}{(r - R + r_0)^2}. \tag{4}$$

Then, by substitution in Eq. (2), the *kinetic viscosity* of the plenum is expressed by

$$w = -\gamma \frac{A V r_0}{(r - D)^2}. \tag{5}$$

In this formula, $D = R - r_0$ is the radius of the circular axis of the "void doughnut" of the vortex core.

The negative sign in the right hand side of Eq. (5) means that the "constraint", or "strength" ("*kinetic reaction*") of kinetic viscosity w works in opposition to the fluid's stream, (i.e., in the direction opposite to that of speed V).

It is worth considering the case of $r = R$, i.e., of $D = R - r_0$, to substitute this in (5) and express the plenum's viscosity between the first two layers of fluid around the vortex ring core as

$$w_0 = -\gamma \frac{A V}{r_0}; \tag{6}$$

this is – in absolute terms – the maximum value of the vortex viscosity. Through (6) it is possible to express the vortex *source speed V* as a function of the plenum's maximum viscosity and of the "thickness" $2r_0$ of the relevant "void doughnut":

$$V = -\frac{w_0 r_0}{\gamma A}. \tag{7}$$

If, as it is reasonable to think, ω_0 is the *constant absolute maximum viscosity* of the plenum, *whatever the vortex*, then Eq. (7) indicates that the source speed V of the vortex, which is also the plenum's maximum speed relative to the particular vortex considered, is directly proportional to the "thickness" $2r_0$ of the ring void core.

Allowing for ω_0 as a *constant absolute maximum kinetic viscosity* of the plenum leads to remark that (bearing in mind Eq. (2′)) there is also a *maximum kinetic tension* τ_0 expressed by

$$\tau_0 = \frac{w_0}{A}, \tag{8}$$

beyond which the "strength" of viscosity ω_0 cannot hold the continuity of the plenum's substance: the plenum can only break around a *void core* and give origin to a closed vortex line, which may be either a ring-vortex or any other kind of vortex.

The presence of a further *nucleus of nothingness* at the centre of the vortex depends on the particular distribution of the plenum's *velocity* around the void core of the vortex ring: if there is a velocity component parallel to the circular axis of the ring-vortex, the opening of a laceration in the plenum is inevitable, with the associated inclusion of a nucleus of void.

2. Decreasing Propagation Speed of the Gravitational Standing Wave

The propagation of the vortex fluid motion across the plenum, starting from the formation stage of the vortex, occurs through a particular standing wave, the motion propagation direction being orthogonal to the velocity of the plenum's stream. At each given distance from the vortex centre, the eddy's speed is constant with time, according to a wave-period T that increases with the distance from the vortex motion's origin; so that a fixed wave-length λ is associated with each distance r from the vortex centre. Not to forget, such a standing wave is systematically transversal to its propagation direction because of the incompressibility of the medium.

The transmission speed u of a transverse wave across an incompressible fluid medium is usually expressed by

$$u = \sqrt{\frac{\tau}{\delta}}, \tag{9}$$

where, again, τ is the *transverse stress* affecting two adjacent layers of fluid in a relative laminar motion, and δ is the fluid's density. The transverse stress τ, as already seen with definition (1) is expressed by

$$\tau = \eta \frac{dv}{dr}, \tag{10}$$

η being the *coefficient of dynamic viscosity* of the fluid, and v is the laminar speed of the stream, whose direction is orthogonal to distance r from the fluid motion's origin. Then, by substitution of τ in (9) with the relevant definition (10), the formula for the wave's transmission speed u becomes

$$u = \sqrt{\frac{\eta}{\delta}\frac{dv}{dr}} = \sqrt{\gamma \frac{dv}{dr}} \tag{11}$$

in which γ is the *coefficient* of *kinetic viscosity* of the plenum, as introduced by (2) above.

As to the *propagation* speed of the stream motion (standing wave propagation) in gravitational vortices, one must start from the above definition given for speed u.

Thus, remembering Eq. (4), reconsider now that

$$\frac{dv}{dr} = -\frac{r_0 V}{(r-D)^2}, \quad (4)$$

where $D = R - r_0$. Therefore, also remembering Eq. (7) for *V*, Eq. (11) becomes:

$$u = \sqrt{\frac{w_0 r_0^2}{A(r-D)^2}} = \frac{r_0}{(r-D)}\sqrt{\frac{w_0}{A}} = \frac{U r_0}{r-D}, \quad (12)$$

where $U = \sqrt{w_0/A}$ is a *constant value for all vortices*. Radiuses r_0 and *D* are instead constant quantities that pertain only to each particular vortex considered.

Eq. (12) shows that the *propagation speed u* of the vortex gravitational field is not a constant value, for it decreases with the distance from the vortex core, starting from an *absolute maximum propagation speed U* and according to a decreasing rate directly proportional to that of the vortex eddy's speed *v*. In fact, an immediate implication of Eq. (12) is that at distance *R* from the vortex centre (i.e., when the distance is $R - D = r_0$), at the surface of the ring where the plenum "touches" the "void doughnut", the initial *field propagation speed* is $u \equiv U$; therefore, this is the *absolute* maximum propagation speed of a gravitational field, irrespective of the size of the vortex core. Together with that, it is also easily proved that $u/v = U/V = \text{const}$.

It is worth drawing attention to the fact that the value of the field maximum ***propagation*** *speed U* is intrinsically different from the maximum ***source*** *speed V* at the surface of the core's "void doughnut", since the vortex *source speed V*, as indicated by Eq. (7) (and remembering the preceding definition $U = \sqrt{w_0/A}$), is expressed in its absolute value by

$$|V| = \left|\frac{U^2 r_0}{\gamma}\right|. \quad (7')$$

Moreover, never to forget, velocity vectors $\vec{\mathbf{V}}$ and $\vec{\mathbf{U}}$ (as well as $\vec{\mathbf{v}}$ and $\vec{\mathbf{u}}$, obviously), are constantly orthogonal to each other.

In particular, Eq. (7′) indicates that the absolute value of the vortex *source speed V* exceeds the speed of the *wave maximum transmission speed U* for any value $r_0 > \gamma/U$.

If $\lambda = 2\pi(r-D)$ is the *standing wave length* of a gravitational vortex, then (considering that $\lambda/T = \mu$) the gravitational wave frequency $\mu = 1/T$ is expressed by

$$\mu = \frac{1}{T} = \frac{u}{\lambda} = \frac{U\ r_0}{2\pi(r-D)^2} \approx \frac{U\ r_0}{2\pi\ r^2}, \quad (13)$$

when $r \gg D$.

This means that the *gravitational standing-wave frequency* of a ring vortex decreases approximately with the square distance from the vortex centre.

A further major remark: Because of relations (7) and (7′), it is also evident that ratio V/r_o keeps constant in any ring vortex; this means that *the smaller the vortex the lower its source speed V*, and vice versa. Besides, there is in principle *no fixed limit* to the *source speed*, which is always relative to the *absolute void*. This also means no fixed limit to the size of vortices.

It is clear that the preceding analysis and relevant conclusions make sense only upon the assumption that a *kinetic viscosity*, as per the definition (2) given for *w*, may be attributed to the fluid plenum.

A question arises from the preceding analysis as to whether the conclusions formulated above apply also to the propagation of electromagnetic waves. In its simplest terms, the question is: can waves of light keep their speed and frequency constant in propagating through the plenum?

As discussed in [2] and [3], the magnetic field generated by continuous electrical current in a linear conductor consists in a stationary motion of cylindrical coaxial layers of the surrounding plenum, quite similar to the plenum's motion in a gravitational vortex. Replacing continuous electrical current with an alternate current implies only that the plenum's motion around the conductor inverts its direction periodically, thus generating electromagnetic waves, whose *transverse wave propagation* through the plenum doesn't differ from the propagation mechanics of both magnetic and gravitational standing waves.

3. Conclusion

If a *kinetic viscosity* is inherent in the fluid cosmic plenum, then the propagation of any kind of *transverse* wave through it entails both progressive propagation delay and loss in the wave frequency: the wave's propagation speed decreases with the distance, while the wave frequency decreases with the square distance from the wave's source. This fact implies that *red-shifts* should systematically be detected in waves that propagate across the cosmic space. Thus, the constancy of the propagation speed of light is also questioned.

The wave *propagation speed* cannot exceed a fixed absolute maximum *U*, which is connected with the absolute maximum kinetic viscosity w_0 of the plenum. Both quantities are still to be determined.

The absolute maximum viscosity of the plenum, w_0, is directly proportional to the square of the absolute maximum wave propagation speed *U*. The coefficient of proportionality coincides with the area unit *A* that pertains to the particular measurement system adopted.

In any vortex, the maximum speed *V* of the stream at the vortex origin (i.e., where the plenum's flow "touches" the *void core* of the vortex) depends on the size of the vortex core; it doesn't seem possible to establish an *absolute* maximum value for *V*, which may exceed the absolute maximum propagation speed *U* of transverse waves across the plenum.

The effects of interferences between gravitational and electromagnetic waves shall be analyzed case by case.

References

[1] Mario Ludovico, "Gravitational Vortexes of Cosmic Plenum", *Proceedings of the NPA* **9** (2012).

[2] Mario Ludovico, **Vacuum, Vortices and Gravitation** (EU-Art & Science, Poznań, 2004 -2010).

[3] Mario Ludovico "A Few Notes about Gyroscopes and Antigravity" (2011), www.worldsci.org/people/Mario_Ludovico.