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Potential Role of the Entanglement Velocity of 10^{23} $m \cdot s^{-1}$ To Accommodate Recent Measurements of Large Scale Structures of the Universe

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ABSTRACT

The aggregate of $m^7 \cdot s^{-1}$ from the product of the four geometric terms for increasing dimensions of a closed path (a circle) when set equal to the optimal combinations of the gravitational constant G and the universe's mass, length and time results in a diffusivity term of 10^{23} $m \cdot s^{-1}$. Conversion of the total energy of the universe to volts per meter and Tesla results in a velocity of the same order of magnitude. The required f^6 multiplication to balance the terms solves optimally for a frequency that when divided by the modified Planck's value is the equivalent upper limit of the rest mass of a photon. Several experimental times associated with orbital distances for inertial frames are consistent with this velocity. Calculations indicate that during the final epoch the velocity from the energy derived from universal potential difference over length and magnetic fields will require only a unit frequency adjustment that corresponds to the energy equivalent of one orbit of a Bohr electron. We suggest that one intrinsic process by which large scale structures (Gigaparsec) are organized could involve this "entanglement velocity". It would be correlated with the transformation of "virtual" or subthreshold values of the upper rest mass of photons to their energetic manifestation as the universe emerges from dark energy or matter that is yet to appear.

***Keywords*:** Entanglement velocity; magnetic energy; electric energy; photon rest mass; space-time structure

1. INTRODUCTION

The universe can be described as infinite but bounded with a current approximate volume of 10^{78} m^3 and a mass in the order of 10^{52} kg. The distribution of this mass is not homogeneous but distributed in clusters with a preponderance for greater concentrations along the perceived outer boundary [1]. When units in space-time are distributed in a non-homogeneous manner in a system the involvement of an internal structure that determines this heterogeneity becomes prominent. The description of this internal structure that is likely to exist as multiple dimensions between 10^{-16} m (below the domains of the proton and electron) to 10^{-35} m (Planck's Length) has been reflected by Kaluza-Klein [2] mathematics as well as the extrapolation of the 10^3 order increments of space (Δs) that define levels of discourse [3].

The recent discernment by Hutsemekers et al [4] of large-scale structures for the alignment of groups of quasar polarizations at the Gpc scale (10^{25} m) levels suggests an internal structure to maintain this organization. The distributions would be consistent with the novel theory of gravity by Borowski [5] who conceptualized a vermiculate pattern of energy and dark energy with matter and dark matter to explain the shifts in motion and position of planets and galaxies. If such large-scale organizations of matter within space are maintained dynamically then a phenomenon with supralight velocity capacities could be involved as the integrating process. Here we present evidence for an intrinsic "entanglement" velocity that could accommodate the excess correlation of polarizations across large space reported by Hutsemekers et al [4].

2. PARAMETERS FOR OBTAINING ENTANGLEMENT VELOCITY

From the perspective of the whole universe, one would expect intuitively that parameters that define the entire set should result in a dynamic that was applicable at that level of discourse. We [6] had assumed for simplicity that four dimensional space-time could be the product of the three geometric descriptors for a closed path in conjunction with a spatial representation of temporal duration. We selected a closed boundary as the geometry because rotations of phenomena within a closed loop (a circle) are constantly accelerating. In addition the potential for changes in angular velocity within this loop allowed second derivatives to emerge. One of the most important second derivatives at the boundary condition of the universe is for the surface area of a sphere or 8π. The value is integral to general relativity theories as well as most cosmological assumptions [7].

The consideration of a circle where rotations occur at different angular velocities around an annulus that constitutes its outer shell creates the condition for photons to exhibit a non-zero mass [8]. When the group velocity is not equal to the phase velocity of a moving electromagnetic field several new properties emerge. They include: 1) frequency dependence in the velocity of electromagnetic waves as they penetrate through free space, 2) the emergence of third state of polarization (a longitudinal photon), where the electric field vector is oriented along the line of motion, and, 3) the production of a Debye-Yukawa type of potential where discrete values of energy will affect dispersion around boundary.

Our first method when the three description of a closed path, the circle, was combined with frequency, resulted in the product of $2\pi r$, $4\pi r^2$, $4/3\pi r^3$ and $2\pi rf$, or, $21.3\pi^4 r^7 f$. The higher dimensional aggregate is $m^7 \cdot s^{-1}$ [6]. The resulting optimal combination of universal parameters (G, mass (m), length (d) and time (t)) that resulted in these units was:

$$21.3\pi^4 f = G^2 \cdot m^2 \cdot d \cdot t^3 \qquad (1),$$

where G was the Newtonian Gravitational Constant ($6.67 \cdot 10^{-11}$ $m^3 \cdot kg^{-1} s^{-2}$), m was the estimated mass of the universe ($2.38 \cdot 10^{52}$ kg), d was the width of the universe ($8.86 \cdot 10^{26}$ m) and t was the estimated age ($4.06 \cdot 10^{17}$ s).

The 7^{th} root of the solution resulted in a hypothetical quality that was considered a "diffusing velocity" that was $2.84 \cdot 10^{23}$ $m \cdot s^{-1}$. With this value any point in the universe could be connected with its further point in about 8 min. We labeled this duration to be the "entanglement velocity". In other words, entanglement latency would not be "instantaneous" but require a latency that would be most obvious at macrolevels of space approaching its total boundary.

Application of this entanglement velocity to the duration of local phenomena produced values that were congruent with empirical measurements. For example the dragging of inertia frameworks for satellite orbits was predicted and observed to be ~10^{-16} s [9]. The potential coupling between the movement of protons between hydronium ions and earth-solar distances to accommodate the suspected functional connection between solar activity and earth-surface water was predicted and has been measured to be 10^{-12} s.

Several experimental studies involving two non-local sites each sharing the same magnetic field configurations rotating around a circular array of solenoids where the angular velocity is dissociated from the phase velocity have shown that the excess correlation between reactions occurs within a "window" of about 8 minutes [10]. This effect has been shown for photon emissions from chemical reactions where the simultaneous injection of reactant at each site results in a doubling of the expected photon radiant power flux density. The two non-local spaces respond as if there has been a transposition of space-time axes such that transiently they are the same space.

3. ENTANGLEMENT VELOCITY FROM TOTAL V AND B ENERGIES

The second source of the solution is derived from the manifestation of the ratio between potential difference per unit length, $V \cdot m^{-1}$ ($kg \cdot m \cdot A^{-1}s^{-3}$) and magnetic field (B) intensity ($kg \cdot A^{-1}s^{-2}$). The result is a velocity term: $m \cdot s^{-1}$. Both magnetic field intensity and potential difference within a space is associated with energy. Assuming the total energy (E) of the universe is ~$2.2 \cdot 10^{69}$ J [11] then the equivalent B and $V \cdot m^{-1}$ can be estimated. For B, the relation is:

$$B = \sqrt{(J^{-1} \cdot 2\mu^{-1} \cdot m^3)} \quad (2),$$

where J is the energy, μ is the magnetic susceptibility of a vacuum, and m^3 is volume. For the present estimated volume (assuming sphere with a radius of $1.26 \cdot 10^{26}$ m and a volume of $8.38 \cdot 10^{78}$ m^3) for the universe the value is ~25 nT.

Te equivalent electric energy contained within the universal volume can be described as:

$$V = \sqrt{(2 \cdot E \cdot \varepsilon^{-1})} \quad (3).$$

Assuming the same universal energy quantity the potential difference would be about $2.24 \cdot 10^{40}$ V. Distributed over the current length of $2.52 \cdot 10^{26}$ m, the voltage linear density is $0.89 \cdot 10^{14}$ $V \cdot m^{-1}$.

The quotient of voltage distribution ($V \cdot m^{-1}$), $0.89 \cdot 10^{14}$ $V \cdot m^{-1}$, and B, $2.5 \cdot 10^{-8}$ T, for the current condition, would be $0.36 \cdot 10^{22}$ $m \cdot s^{-1}$. If the intrinsic structure of the universe as inferred by the most persistent geometric expression 8π (the second derivative of a spherical surface) is multiplied, the value is $0.91 \cdot 10^{23}$ $m \cdot s^{-1}$. This is within the same order of magnitude and approaches the coefficient of that derived from the universal values (equation 1) that define the universal set. However a more convergent solution that could accommodate the discrepancy of coefficients could be revealing.

4. INTRINSIC CONNECTION OF THE TWO SOLUTIONS

The solution of $\sim 10^{23}$ $m \cdot s^{-1}$ derived from two sets of assumptions and different universal parameters suggests that further information could be discerned by setting them as equalities. However for the equations to be equal a higher order frequency term must be added such that:

$$(m^7 \cdot s^{-1}) \cdot s^{-6} = m^7 \cdot s^{-7} \quad (4).$$

In other words for the 7th root of the velocity term derived from equations (2) and (3) to be equal to the result of product of $G^2 \cdot kg^2 \cdot d \cdot s^3$ (1) derived from the four-dimensional (space-time) geometric solution, f^6 is required. Clearly the base value for f must approach values around 1 Hz or, considering the large order of the exponents, there would be non-convergence.

For the contemporary universe the quantitative values would be:

$$G^2 \cdot m^2 \cdot d \cdot t^3 \cdot f^6 = [(V \cdot m^{-1}) \cdot B^{-1}]^7 \quad (5),$$

or,

$$1.49 \cdot 10^{164}\ m^7 \cdot s^{-1}\ (3.35 \cdot 10^{-4}\ s^{-6}) = 4.97 \cdot 10^{160}\ m^7 \cdot s^{-7}.$$

The s^{-6} value is required to balance the equation. The sixth root of that value is $2.63 \cdot 10^{-1}$ Hz or the equivalent (by multiplying by the modified Planck's constant ħ ($1.06 \cdot 10^{-34}$ J·s) resulting in $2.78 \cdot 10^{-35}$ J. This unit of energy is equivalent to the upper limit of the rest mass of a photon which has been estimated to be 10^{-52} kg with coefficients ranging from 1 to 3. In this instance the value would be $\sim 3 \cdot 10^{-52}$ kg which is very similar to the value based upon other derivations [12]. If the original Plank's constant were to be required the linear distance of the circumference the boundary of the current universe would be required to obtain the initial voltage gradient.

One interpretation of these results is that the "diffusion velocity" derived from the appropriate combination of G, width of the universe, its age, and its mass is related to the velocity produced by the ratio of the voltage gradient to the magnetic field values by a frequency that at the quantum level is the equivalent of the upper rest mass of the photon. We suggest the two values converge and may be identities *because* of the process that transforms the rest mass photon to its energetic form.

5. FINAL EPOCH SOLUTIONS

The final epoch of the universe based upon several models estimated a temporal boundary of about 98 billion years [13]. Consequently the present age, which constitutes about 13% of the total potential duration would suggest the early stages of the ontogenetic process. Persinger [14] has suggested that the dominance of dark matter and dark energy is the matter and energy yet to be manifested. This concept is convergent with the new gravitational theories of Borowski [5] and Eddington's [7,15] "dormant" particles or entities.

Assuming the velocity of c does not change appreciably the diameter of the universe at the final epoch would be $17.98 \cdot 10^{26}$ m. Assuming the current energy the voltage gradient would then be $0.12 \cdot 10^{14}$ $V \cdot m^{-1}$ and the magnetic field strength would be $1.4 \cdot 10^{-9}$ T. The ratio

results in a "diffusion" velocity of $0.89 \cdot 10^{23}$ m·s^{-1}. When multiplied by the implicit geometric representation 8π the velocity would be $2.23 \cdot 10^{23}$ m·s^{-1}.

Considering the intrinsic measurement estimates and the standard deviations of measurement, which are about 30% of the central tendency in a normal distribution, the diffusion velocity during the final epoch would be the same value as the one derived from equation (1). This could indicate that the intermediate frequency term (s^{-6}) would effectively be 1 Hz or the energy involved with one completion of an electron in a Bohr orbit. One implication is that during the final epoch the energy that is now represented in rest mass photons that are embedded in the structure of space or have not emerged as a function of time would be completely manifested. Whether or not this reflects an important property of dark matter and energy has yet to be discerned.

6. IMPLICATIONS

Although entanglement and excess correlations have been assumed to be "instantaneous" in a manner similar to earlier views that the velocity of light in a vacuum was "instantaneous", there may be a quantitative value. Two separate approaches indicated an order of magnitude of 10^{23} m·s^{-1}. In order to produce the equivalence in their dimensional analyses a temporal factor was required that strongly suggested the central role of the transformation of the rest mass of a photon to its energetic form. Photons are considered to be the most likely entity through which entanglement has occurred and excess correlations occur [16,17].

A value of 10^{23} m·s^{-1} would be in the order required, intuitively, to maintain the alignment of large-scale structures that has recently been observed and reported [4]. At Gpc scales in the order of 10^{25} m, processes could interact within the order of 100 s. With this velocity transit time across the universal width would be in the order of ~8 minutes which is the range of "excess correlations" durations between locations separated by non-traditional distances that we have found for a variety of experiments in the laboratory involving both photon emissions [10] and shifts in proton density within water [18].

This value when applied to satellite orbits is within the same order of magnitude as the estimated drag for inertial frameworks, that is $\sim 10^{-16}$ s [9]. The application of this velocity to the distance between the sun and earth results in latency of 10^{-12} s. This is the approximate life time of the hydronium ion within normal water. This ubiquitous array of Grotthuss exchanges forms the primary bases for pH and the essential boundaries for living systems.

It may be relevant, considering the recent comparisons of photon emissions from the human brain during imagination and the radiant flux density from specific regions of the galaxy, such as the star Mintaka in Orion's Belt [19], that very large distances solve for durations that overlap with cerebral processes. For example the time required to traverse the distance between the solar system and the center of the galaxy for some process moving at 10^{23} m·s^{-1} would be about 1 ms.

This is the duration of the must fundamental component of cerebral processing, the neuron's action potential which is associated with the universal quantum of 10^{-20} J [20,21]. Such a quantitative relationship would be consistent with the perspective boldly presented by Eddington [15] during the late 19th century and early 20th century but now has been larger forgotten.

7. CONCLUSIONS

There may be a quantitative value associated with the time required for excess correlations or non-locality that exceed the velocity of light and may be significantly contributory to the organization and maintenance of large scale structures over distances that approach the width of the universe. Two methods of analysis derived from universal values and separately from the total energy of the universe within electric and magnetic components indicate the velocity is $\sim 10^{23}$ $m \cdot s^{-1}$. Equity between the dimensional analyses of the two solutions required a frequency term whose value when divided by Planck's constant would be within the range of the upper limit of rest mass of a photon when the intrinsic structure of 8π is included. However at the final epoch this frequency term would be reduced to the equivalent of one orbit of an electron. The most parsimonious explanation is that entanglement velocity involves the ongoing conversion of dark energy as subthreshold ("virtual") photon masses into measureable photon energies.

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