How the Relativistic Redshift May Help Clarify the Universe's Geometry *

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Abstract

The idea [1] is pursued that the propagation of a wave-front of a light signal cause it to rotate into a flattened shape which has to be restored, before absorption, into the original, much more rounded shape the wave-front had when the signal was emitted. The equations describing the relativistic Doppler shift are rearranged in order to accommodate this rotation. As a result, the locally observed frequency of the radiation becomes modulated by the tangent of some angle. The angle and the frequency shift can be determined in a universe which has a line increment of equal magnitude per unit length in the direction of observation. This construction tends to relieve the so called 'Hubble tension', that is, the finding in astrophysics that the local apparent expansion rate is somewhat higher than that at remote places in the universe. Since the results imply that the cosmological redshift has its origin at the recipient's matter-signalwave interface the behavior of the electron is examined. If the electron has a signal-receiving axis which is tilted by 45 degrees relative to the incoming wavefront-signal it is capable of adjusting by a rotation both receding and approaching emitter velocities to a reference frequency contained in the same signal but phase-shifted. In the case that the unit circle with time *versus* length preserves its area, then a time dilation occurs in both the receding and approaching cases. The electron adjusts (by a rotation) a phase mismatch within the signal caused by two perpendicular signal components of which only the longitudinal one is relativistically distorted. In this theoretical construct the absorption of a relativistically distorted signal wave takes place by a mutual rotation between the electron and the signal. The latter is modeled as a rotation in space whereby simple velocity addition arguments yield that it too must be compensated by a counter-rotation that takes place upon absorption. Since the gravitational redshift from a relativistic horizon has a similar form as the relativistic Doppler shift it is evaluated in terms of this theory. If one cancels the factors 2GM by spreading out the universe's mass along its diameter, making the universe one-dimensional, then a squared velocity can be retrieved in place of the factors 2GM/r. In such a universe the signal from the remote location is rotated like in the Doppler case while the local signal recipient sees the signal receding linearly proportional to distance.

Keywords: Black hole, cosmological horizon, redshift, electron, geometry of the universe

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1 Introduction, Theory, and Discussion

Everybody would probably agree on what the world is - the material world surrounding us with its physical objects, its physical laws, its light and darkness etc. So, when recent scientific theories leak out through the mass media that the world might be a 'hologram' or a 'computer simulation' it is somewhat disturbing. However, isn't the human intellect itself that puts together all the knowledge about the real world into a comprehensive world picture somewhat like an information-processing computer? What does the world look like from the perspective of its more elementary constituents - its atoms and molecules? These have no means of getting a comprehensive picture of the world, their information exchange with it is mostly limited to short-lived interactions *via* momentum transfer or electromagnetic signal absorption or emission. The light signal may be taken as an example of how human intuition and actual physics are set to clash, in the following pursuing a theory being developed by the author [2] [3] [4] [1].

Everybody 'knows' that light can be described as a wave with oscillating electric and magnetic fields perpendicular to the direction of light's propagation at velocity c in vacuum. This has been shown beyond doubt in bench-top experiments and explained theoretically by means of e.g. Maxwell's equations and the 'Faraday tensor'. The weak point in these descriptions, however, is that they lack any notion of the 2-dimensional spherical wave-front of the signal. Relatedly, as has been brought into the focus recently, they lack the notion of 'non-locality' *alias* 'entanglement' *alias* superpositions. These shortcomings motivate searching for a more comprehensive theory.

Hence, it is possible to rearrange the Faraday tensor, its electric component, into two components which, by comparison with founding theory [5], represent 1) linear momentum and 2) a component of curl that is perpendicular to the linear momentum and therefore 'non-local' relative to it. This mathematical-geometrical construct invokes a one-dimensional local world that receives linear momentum and communicates *via* Lorentz transformations with a non-local world which is hidden (from the local observer) in the invisible curls at the nodes of the electromagnetic radiation. Such curls, when canceled in adjacent cells of curl ('Stokes' curl, that is) may encompass the entire wavefront and may allow communication (at phase velocities) within the wavefront, perpendicular to the signal propagation at velocity c. This mathematical construct (which decomposes the Faraday tensor of the Minkowsky geometry) provides a geometrical framework for non-locality in two ways, namely, A) the canceling Stokes curls just mentioned which coincide with the nodes of the signal. B) It reduces the three dimensions perceived by the human intellect (the human 'computer') into one dimension only, along the linear momentum axis (which also accommodates axial vectors), to the effect that the two remaining spatial dimensions are not seen by the particle - they become 'non-local'.

The validity of this geometrical construct has been evaluated both for the orbiting atomic electron [2] and the atomic nucleus [6]. In addition, as shown previously by the author, many equations in physics can be rearranged into their local and non-local factors, which improves the understanding of the physical processes that the equations describe.

As for electromagnetic (EM) signal-processing, it was postulated that the non-local electron (in its 'cloud) captures the signal in the latter's non-local wavefront leading to absorption of the signal by way of a Lorentz transformation which involves rotations taking place in the electron and in the signal-wave. This also leads to linear momentum transfer since a Lorentz transformation, mathematically, can be decomposed into a rotation and a 'boost'. It suffices to rearrange in this way one component only, of the Faraday tensor in order to transit from the classical description of the electromagnetic 'wave' seen in the laboratory to physical processes arguably taking place in the physical world at the particle level. This indicates that actual physical processes may be concealed in (special) relativity theory (SR) and can be rescued from there and made understandable, just by rearranging terms. In the case

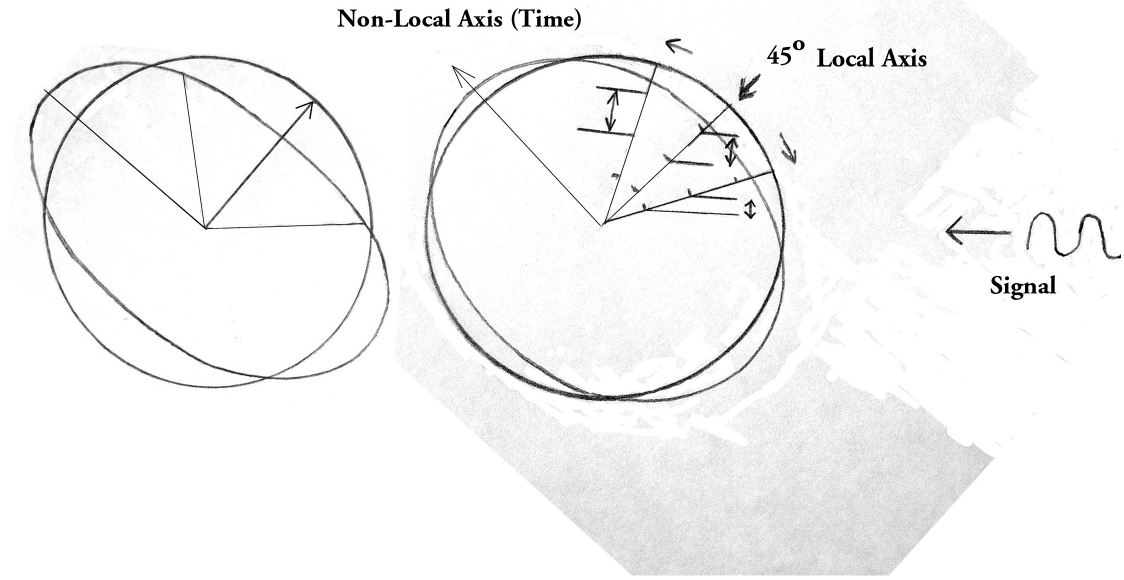

Figure 1: Schematic illustration of how the electron, when its local axis is tilted at 45^o relative to the incoming radiation, can adjust by a rotation any mismatch of pitch arising from receding or approaching emitter velocities. Receding and approaching velocities cause the wavelength to be respectively longer and shorter. Depending on whether the wavelength or the frequency is important for adjusting the mismatch the electron will tilt its local axis up or down as indicated by the two bent arrows following the circumference at 45^o. The two-way arrows perpendicular to the signal propagation, drawn inside the circle, indicate how the tilt causes the pitch of the electron's local receiving axis to become longer or shorter as seen by the signal. The ellipse indicates how the non-local axis becomes elongated as a consequence of the unit circle maintaining its surface area when the local axis is contracted. This squeezing of the non-local axis is interpreted as a time dilatation taking place both when the emitter is receding and approaching (as embedded in SR). Contemplating with the help of the drawing how this might happen reveals a fundamental difference between continuous time and discrete time. In the case of continuous time, the scales of the axes are determined comprehensively at any instant to make the surface area of the circle-ellipse equal. In contrast, sequential processes, cf. [2], defining time intervals (like quantum jumps in signal processing) may cause the axes to stretch or contract sequentially.

of the orbiting electron, for example, it was found that if the electron absorbs the signal equally in its non-local part (the curls at the signal node) and its local part (the antinode) then it is likely that it (the electron) is tilted by 45^o against the wavefront. If so, it would be capable of adjusting frequency mismatches caused by both receding and approaching emitter velocities by adjusting its tilt. This is illustrated in Fig. 1.

When evaluating Fig. 1 it is important to be aware of the two prevalent concepts of electromagnetic radiation; that it might be a particle - a photon, or that it is a wave. Fig. 1 illustrates how the electron might adjust to a frequency mismatch while the signal is absorbed (cf [2]) from two components of a wave (the wave remains a wave during absorption), one component perpendicular to the signal propagation, which is not affected by the emitter's to-and-fro velocities and another component parallel to the signal propagation, which is relativistically distorted. From this simple graphical construction one arrives at the conclusion that the electron is capable of taking on 'relativistic effects' very literally by rotating, and while rotating also compensating any frequency mismatch within the wave - it arguably reclaims its own physics from RT. This may be described mathematically as

$$\overline{E_y} = \frac{c\sqrt{1-v^2/c^2}}{v}\underbrace{\left[\frac{v}{c\sqrt{1-v^2/c^2}}\overline{E_y}\right] - \frac{v}{c}\overline{B_z}}_{non-local observer, E} + \frac{v}{c}\overline{B_z} \quad . \tag{1}$$

The non-local matter wave in the electron cloud meets the non-local signal front such as to collapse into a local (barred symbols) phenomenon - the signal seen in the laboratory. Hence, besides very likely revealing real physical processes hidden in RT this interpretation of the absorption indicates that the wavefront *per se* and particularly its non-local part play a important roles.

As in Eq. 1 one may thus regard the signal *per se* as a rotation in space propagating with velocity c perceived as undulations in the laboratory. This picture embodies two arguments. The first one is based on simple velocity addition. If, for example, the rotation goes clockwise at velocity V_R like in Fig. 2 and the emitter to the left recedes with velocity v from the observer to the right (not penned) then the summed velocities at 12 o'clock and 6 o'clock in the drawing will be projected differently on the local axis: If so, the projection of the rotation onto the local axis would look different and consequently it would seem to be emitted with another wavelength. This argument is not restrained by the statement of SR that $v < c$ since a rotation may be regarded as a phase velocity and phase velocities higher than c are allowed in SR[1]. Furthermore, one may bypass the dogma of SR that all velocities are relative within an all-comprising geometrical framework since velocities may be added locally (cf. [7]) relative to the most adjacent vicinity, in the present case the signal at the instant of just leaving the emitter. In such cases with receding or approaching emitter velocities adding to V_R the above described imbalance can be compensated by a plain rotation at the matter-signalwave interface - this rotation may, in principle, take place in the matter wave or the signal wave or in both, at the emitter and/or at the receiver end of the signal, as described by Eq. 1[2]. These rotations produce equivalent effects in the receding or approaching scenarios, thus alluding to the 'time dilation' of SR like discussed above in connection with Fig. 1.

The second argument embodied in Fig. 2 comes from regarding the signal as equal but distinguishable contributions from its non-local (the nodes where the curls are, that is) and local (the field maxima which are seen in the laboratory) parts. If one puts the local contribution at the x-axis (0^o) and the non-local one at $\pi/2$ this contribution has a maximum at $\pi/4$ which is where the visible fields change magnitude (accelerate) most. Arguably, unless these contributions are equal there will be a mismatch of 'energy' between the local and the non-local contributions, which can be avoided by a compensatory rotation towards 45^o at the moment of absorption. Pursuing this idea [2] leads to the notion that the signal is absorbed from the wave in two stages, first from its non-local part (which is detected by the electron cloud in its non-local frame of observation) and subsequently from *its* local part.

These constructions above resolve the abstract geometry of SR into a robust physical process - a challenging first. Certainly, SR can describe many other phenomena which escape these ideas (at a glance) but one has to start somewhere[3].

Consider then the cosmological redshift, the reddening of electromagnetic radiation coming from distant astrophysical objects such as stars, galaxies, gas clouds or anything far away that is visible in the telescopes. Its Doppler redshift is often written as

[1] E.g., superpositions, teleportations, etc. are often documented in terms of phase differences

[2] Bench-top experiments with relativistically distorted light may verify or refute these mechanisms, difficult to make but perhaps not so far off given the level of sophistication of contemportary investigations of light.

[3] see for example [6] for a similar approach to treating physical mass in terms of the equivalent mass of the apparent local cosmological expansion rate

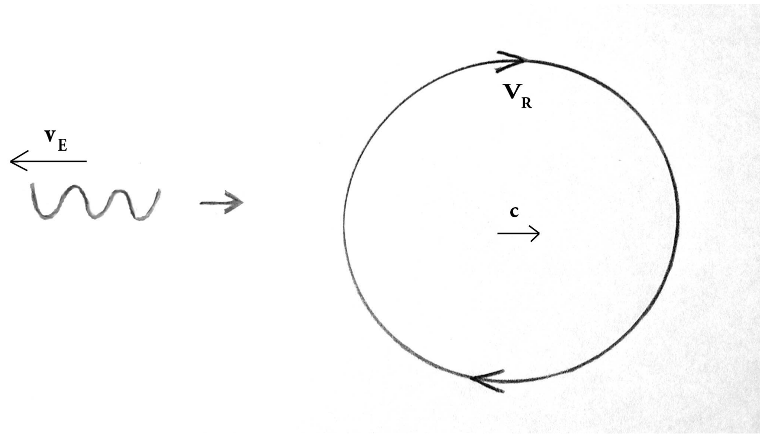

Figure 2: Schematic illustration of the problem of velocity additions around a signal traveling with the velocity of light, not in the form of an undulation along its propagation axis but as a rotation in space. This is discussed in the text. As for the validity of $v < c$ it is noted that if light propagates with velocity c and it has a wave-front then the wave-front must spread with velocity at least $2\pi c$. V_R = velocity of rotation, V_E = emitter's velocity relative to signal absorber.

$$\frac{\lambda_r}{\lambda_e} = \sqrt{\frac{1+\beta}{1-\beta}} \tag{2}$$

in order to highlight that one is (mostly) thinking of a concomitant literal stretching of the wavelength (λ) observed (r = receiver) as it travels through the expanding universe at speed $v = \beta c$ from the emitter (= e). In the present case, however, where rotations at the matter-signalwave are contemplated, it is natural to start from the relativistic Doppler shift in the form (ν=frequency, $\nu = c/\lambda$)

$$\nu_r = \frac{1 - \frac{v}{c}}{\sqrt{1 - \frac{v^2}{c^2}}}, \qquad \nu_e > \nu_r \tag{3}$$

where v[4] is the receding velocity and rearrange to

$$\underbrace{\nu_r}_{receiver} \underbrace{\frac{v}{c}}_{A} = \underbrace{\nu_e}_{emitter} \underbrace{\left(1 - \frac{v}{c}\right)}_{B} \underbrace{\frac{v}{c\sqrt{1 - \frac{v^2}{c^2}}}}_{rot} \tag{4}$$

where the terms A and B represent the linear contributions (stemming from receding velocities): The term B represents the loss of momentum as seen by the receiver (left) due to the recession while the term A preserves that same subtracted part of the momentum for the emitter ($\nu_e \rightarrow \nu_e \times v/c$). This is at first sight just a mathematical balance sheet since the emitter has no way of knowing its velocity relative to the signal absorber. In the present theory, however, the relativistic effects take place at the recipient-signal interface, starting in a *non-local* frame of observation where part of the signal in principle may be given back to the vacuum, non-locally. The fifth term labeled '*rot*' is known as the tangent of the angle by which an orbiting point is seen delayed from the origin so it represents a rotation. (This is different from SR where the non-linearity of Eq. 4 would stem from its so called 'time simultaneity' - a concept which relies on the hypothesis that all physical processes including quantum

[4]The velocity and frequency terms herein contribute to the momentum since $\nu = E/h = mc^2/h$ has mass, m and momentum = $p = m \times v$

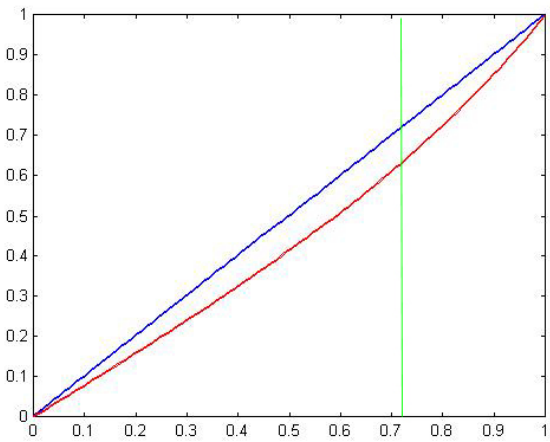

Figure 3: Copied from [1]: The adjustment to the frequency observed locally, caused by the rotation factor in Eqs. 4 and 5. Graphical illustration of the 'linear universe 'where each unit length along the line of sight has a line increment embedded in it (blue curve). This is plotted as linearly proportional to an angle divided by 45^o spanning from the origin to 45^o .The red curve is the tangent, $sinx/cosx$, which expresses the (lack of) torque in the signal and/or its correction to the spatial configuration the signal had when it left the source.

ones take place sequentially on a continuous universal time-axis.) Accordingly, Eq. 4 can be written

$$\nu_r \frac{v}{c} = \nu_e \left(1 - \frac{v}{c}\right) \frac{sin\ \phi}{cos\ \phi} \tag{5}$$

If it were not for the careful deliberations that were summarized above this would seem to be just an awkward way of twisting about the geometrical framework of SR. However, arguments have been presented above that the rotation is an actual physical process. Furthermore, the fifth term is precisely the factor shown graphically to relieve somewhat the 'Hubble tension' [1] based on the argument that the signal must restore from a very flattened wavefront the more rounded shape it had when emitted - necessitating a rotation[5]. This factor was referenced to a linear universe ([1]and Fig. 3 above), which has an equally long line increment (the local Hubble 'expansion', that is) per unit length in any of its length segments along the direction of observation[6]: The rotation factor decreases the linearity at remote distances since $sin\phi/cos\phi$ is approximately equal to $sin\phi \approx$ y-axis only for low values of ϕ (low values of y represent the local universe) yielding a plausible empirical fit, at least based on redshift (cf. [1], Fig. 3) The rotation of the wavefront was examined from zero degrees to 45^o, the latter was taken to represent the cosmological horizon where the line increments (in the present theory) add up to one unit length per geometrized second - the universe's relativistic horizon.

The idea that the signal 'looses energy' while spreading in the wavefront is no more strange than

[5]The flattening of the wavefront being equivalent of a rotation can be evaluated by picking a circle segment of some length, fixing one end of it to the x-axis and following the other end while altering the circle's radius.

[6]This is compatible with the widely accepted idea that the universe should look the same on a large scale from wherever it is observed

that an object falling into a black hole looses 'gravitational potential'. Furthermore, it is already known that a signal near a gravitating object is redshifted so, arguably, the cosmological horizon may be 'heavy'[7]. By analogy with the atom, one may imagine oneself sitting on an electron seeing the atomic nucleus orbiting so rapidly that it appears as a non-local wave; the atomic equivalent of a heavy cosmological horizon. Such a geometry would solve the problem of the closure of the universe; the vexing dilemma of contemporary cosmology of whether it is expanding forever, stationary, or if it will collapse back onto itself.

This analogy with the atom brings up the issue of whether or not the universe rotates. Namely, if one pursues the idea of the universe having the same intrinsic geometry as an atom then sitting on an electron is the right place to be, and the electron rotates. From the perspective of the atomic electron, because of its angular momentum (indicating a literal rotation.... though much discussed in the literature) and because of its orbit, everything around it seems to rotate. While it orients itself to the charged nucleus and proceeds from a locality to the next place in its orbit its tilt will change relative to where it was first noted, whether detectable or not, - this constitutes a rotation analogous to that deduced above for the relativistic Doppler shift. One must conclude from the latter, as discussed above, that it is not obligatory to observe a rotation even if there is one taking place[8] and the same applies at the scale of the universe when one evaluates whether or not the universe has the same geometry as an atom. In electromagnetic radiation the rotations around the rapidly changing electric and magnetic fields at the nodes are not detectable - they are non-local, alternatively - everywhere canceling, and hence 'yonder' from the perspective of the local observer. Furthermore, no one knows if the 'black matter' or the 'dark energy' of contemporary cosmology rotate - if there are any such things. In fact, almost every heavy and dense object in the universe seems to rotate and so does the universe itself at least when canceling its 'dark' components by seeing it from the perspective of a rotating Earth [8].

With all this in mind turn to the 'gravitational redshift' in the form

$$\frac{\nu_{emitter}}{\nu_{observer}} = \frac{\lambda_{observer}}{\lambda_{emitter}} = \frac{1}{\sqrt{1 - r_S/r_{emitter}}} \qquad with \qquad r_S = \frac{2GM}{c^2} \tag{6}$$

where r_S is the Schwarzchild radius of a black hole from where no signal can escape, G is the gravitational constant, M is the mass that affects the signal, and r_E is the distance of the emitter from the center of M. The observer at ∞ is not influenced by M. This equation lacks the linear terms of Eq. 4 since there are no to-and-fro velocities. If one evaluates a possible analogy with Eq. 4 then one would like to keep c^2 in the denominator within the brackets and interpret the factor $2GM/r_{emitter}$ as a squared velocity - it does have the same unit-dimensions as a squared velocity. This factor is known as the 'gravitational potential'. Then by analogy with Eq. 4

$$\frac{1}{c}\sqrt{\frac{2GM}{r_E}}\lambda_\infty = \lambda_E \frac{\sqrt{2GM/R_E}}{c\sqrt{1-(2GM)/c^2 r_E}} \tag{7}$$

if one is interested in the wavelengths, and

$$\frac{1}{c}\sqrt{\frac{2GM}{r_E}}\nu_E = \nu_\infty \frac{\sqrt{2GM/R_E}}{c\sqrt{1-(2GM)/c^2 r_E}} \tag{8}$$

if one is interested in the frequency-momentum of the signal. The place to look for a squared velocity in this case might be in the 'kinetic energy' of a mass or the 'centrifugal force' acting on a mass. The

[7]Contemporary astronomical observations again and again yield evidence of surprisingly (read: not compatible with the 'Big Bang' model of the universe) heavy objects at very remote locations

[8]The 'wave' seen in the laboratory may have its origin in rotations, as discussed above

task of finding v^2 is compounded by the fact that neither energy, nor force, nor gravitational potential are physical processes so how (?) is one to find the real thing taking place with the help these abstract mathematical constructs that have evolved from the mysticism of the alchemist era, fundamentally the same as in those times, but with higher and higher academic sophistication. In the present case it is preferable to evaluate the original theory [5] where the inverse of the radius is a line increment, $\overline{\Delta q}$ in units of m/s [9], which is interpreted as the local apparent cosmological expansion of each and every unit length along the line of sight and write

$$\frac{2GM}{r_E} \longrightarrow 2GM\frac{{r_E}^{-1}}{s} \tag{9}$$

made unit-compatible so that $2GM$ too represents a velocity and this latter velocity is, like c, just a constant. In the case that M represents the mass of the universe (or that of a black hole at the universe's horizon) and it is equally distributed along the latter's diameter, for example, one may divide the magnitude of 2GM by the magnitude of 2GM[10]. Then one gets a squared velocity out of the term $2GM/r_E \rightarrow {v_E}^2$. There are probably better, more geometrically elaborate ways to deal with this problem (that is, how to get a squared velocity) but the one chosen here is justified in a one-dimensional universe seen by a particle on its one-dimensional momentum axis where each unit length has the same line increment also comprising geometrized mass. Since the cosmology favored in this series of papers is linear along the line of sight, the position (coordinate) of the emitter at r_E also has a characteristic velocity relative to the remote horizon and relative to the receiver of the signal (cf. Fig. 3). Summarizing from the above applied to Eq. 8,

$$\underbrace{\frac{v_E}{c}\,\nu_E = \underbrace{\frac{v_E}{c\sqrt{1-\frac{{v_E}^2}{c^2}}}}_{A}\,\nu_\infty}_{B} \,. \tag{10}$$

Here, the momentum signal from the emitter undergoes the same weakening as in Eq. 5, expressed by $sin\phi/cos\phi$ (the terms collected by the letter 'A') and interpretable as a rotation while the Terrestrial observer at the (apparent) center of the universe calculates the momentum of the signal to be weakened linearly in proportion to the apparent receding velocity (the terms collected by the letter 'B', excluding 'A') , which is less the closer the emitter is ($r_E \uparrow \;\; \Rightarrow \; r^{-1} \downarrow \;\; \Rightarrow \; v_R \downarrow$)

In conclusion; could the universe's relativistic horizon where its line increments per unit length add up to the velocity of light (in the present linear cosmology at least) be the Schwarzchild radius of an inverted black hole that has flattened into an envelope, a 'halo'? If the universe has this kind of geometry then the closure problem of contemporary cosmology would be solved and a lot of standard theory would have to be rethought. One example is the 'Hubble tension' mentioned here and in [9] which seems to be amenable to analysis based on the present ideas.

Behind all this one catches a glimpse of a giant - the electron. Does it have substructure as inferred herein by its pitch on the receiving axis or is the pitch just some kind of harmonics? In particle physics, the notion of substructure in the form of 'quarks' is already well established. These are made observable under extreme experimental conditions. The electron has also revealed some evidence of substructure in terms of charge and mass separation. The present results show that, in

[9] s denotes geometrized unit of time, non-standard notation

[10] This may seem like omitting some important physics but in mathematics almost anything seems possible: Just think about how relativity theory ignores the important physics of the velocity of light [7], Planck's constant [6] and, why not, the mechanism of absorption-emission-redshift discussed in this paper. Here, one is talking about challenging physical processes yet to discover while in SR-GR one is talking about abstract geometry based on the 400 years' old mysticism of the alchemist era (forces, that is) knowingly having reached the end of an impasse (dark matter-energy, that is).

addition to direct observation, it is possible to infer substructure by elaborating on the hypothesis that......if it were that way? In the case of the electron this approach has given a rich harvest. For example, besides the results on its possible absorption mechanisms summarized herein (cf. [2]) and its capability of inverting our palpable world (making a wave out of the atomic nucleus, that is Ch. 6 in [3]), the discovery that its time axis may be squeezed such as to cause time dilation brings in the so called 'free radicals' in biochemistry, reactive chemical species (unstable electrons) that cause 'aging', hence contracting the time axis at the cellular level. Some aspects of mental cognition may be likened to a process that settles in distinguishable abstract concepts - like if fermions were formed [10] while there is an exponential decay - decoherence. The electrons do cause breakdown of superpositions. By virtue of their capability to absorb and emit electromagnetic radiation they have to be involved somehow in cognitive 'brain waves' that are known to exist (experimental evidence of a 'soul', maybe) but little understood. And now isn't it, again, the electron that takes the lead towards a better understanding the geometry of the universe?

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