Reshaping the Electron .....Once More. *

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Abstract

The orbiting electron is reexamined with the aim of explaining why it appears in so many forms; orbiting particle, quantum-mechanical wave, probability cloud, etc. It is argued that it emerges in all those forms from self-canceling circular cells of 'Stokes curl', which are non-local. The diameter of these founding curls, their velocity, and frequency in the Bohr atom ground state are determined and related numerically to the electron's deBroglie oscillation, the Compton wavelength and the Dirac magnetic monopole. The electron can be followed as a group velocity of oscillating matter and charge, which is capable of absorbing electromagnetic radiation by resonance within the electric fields. A Lorentz transformation then mediates a rotation of the electric field followed by a boost of momentum; a robust physical process which follows the phase of the wave during absorption in contrast to the idea of particulate momentum transfer in an abstract embedding space-time geometry. The electron's group velocity is expressed in terms of the local line increment in cosmology which shows that the fine structure constant measures the acceleration of the magnetic field of the curl cells. The present theory offers an innovative perspective on many of contemporary physics' frontier dilemmas such as its non-locality of signal transmission, the nature of matter, and the geometry of the universe. These problems are herein all manifestly recast in terms of the present theory.

1 Introduction

The electron is not just a particle it is the enticing challenge of the world to be understood and the changing face of evolving physics in one. From thunderstorm lightning to carrier of electricity to atom - the electron shapes the physical world and eludes comprehension nevertheless. Watching a spark is clear evidence that there must be something beyond the tangible world so, ultimately, the notion of a particle of charge was born which lead to the discovery of the atom. The perceived role of the electron in the atom has changed since then, from orbiting particle to a wave to a cloud, as illustrated in Fig. 1.

Since it evokes all these vastly different descriptions, what is it really? All have been verified experimentally in turn by 'Rydberg states', wave mechanics and electron microscopy. It is difficult

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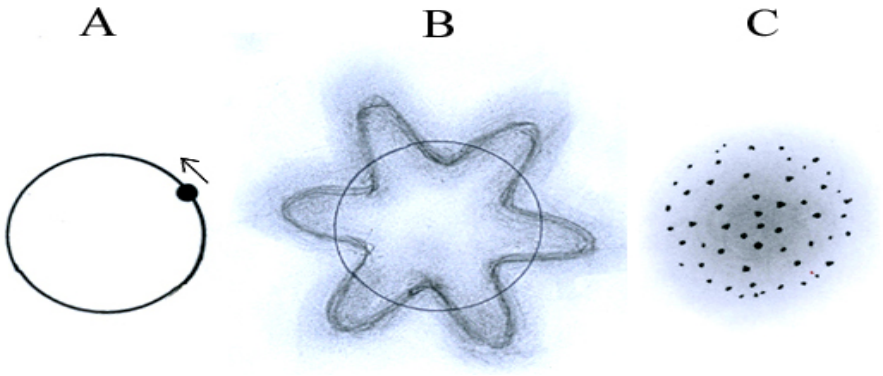

Figure 1: Schematic illustration in one dimension of how the electron has been conceived in physics through the years, in A the orbiting point particle of the Bohr atom, in B the deBroglie matter wave and in C the Schrödinger electron cloud. In A, the electron moves literally, in B it forms a standing wave and in C, it appears randomly with certain probabilities

to imagine intuitively that an orbiting local particle also is a wave that extends probabilistically into three dimensions. In order to understand this metamorphosis going on in the atom one has to abandon the idea that the electron is local and search for an alternative description. Since it appears in different forms depending on how it is poked at it ought to have a more indifferent ground state from where it emerges in all those different forms. A common basis for its various appearances seems to be the 'group velocity' of matter waves, which arises by addition of waves of slightly different frequencies producing beat waves like in Fig. 2: One can imagine the orbiting electron as composed of many such waves of slightly different frequency with slightly different directions on the atom's surface producing interference within themselves with a high amplitude signaling a presence and zero amplitude an absence of the electron. Such a fundamental process can easily be understood to give rise to all the various appearances of the electron in Fig. 1, which would invoke once again the mystery of what electronic (or any) matter actually is. In the literature of 'group velocity' of waves it has long been agreed upon that this velocity represents the propagation of 'energy' within the wave [1] [2]. Subsequently, the discovery that this includes the material electron - point particle [3][4] brought about the development of wave mechanics (revolutionizing early 20:th century physics) and, in retrospect much later, the notion of non-locality in physics (where physics is today). Obviously, the group velocity is a very important phenomenon. It is possible to understand that it may be related to the kinetic energy and friction of molecules in water - the classical 'energy' in the shape of perturbed ('cracked') wave harmonics, but how might it be related to the matter of the orbiting electron? This has not yet been examined since no one really knows what matter is and the concept of 'energy' is even more vague and pliable so the group velocity offers an opportunity to reexamine these things.

Is the celebrated contemporary view correct that matter was bestowed upon all local particles on the first day of creation (read: 'Big Bang') because of a valley in the Mexican hat-like energy profile of some symmetry -braking process followed by the particles' friction in an omnipresent matter field? This sounds pedagogical but is it a sober description of the actual physics going on? May be not: This paper will focus on how to describe an electron's proper ground state including its matter in an intuitively acceptable way ultimately aiming at its renowned 'energy levels' in absorption-emission.

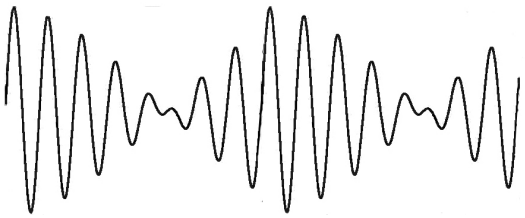

Figure 2: Recapitulation of how the group velocity arises by adding the amplitudes of two propagating waves having slightly different frequency. This generates a 'wave packet' exhibiting a beat of amplitudes the velocity and direction of which are not necessarily the same as in the constituting waves. In the case of the orbiting electron the velocity of the wave packet is that of the electron but the generating waves are not evident at all.

2 Results

The starting point for this effort is the author's own results of 20+ years that 1) matter arises from the geometrized energy equivalent of the local (apparent) cosmological expansion per unit space and unit time taking place at the circumference of an object stretching to here from a non-local origin (e.g. refs. [5] - [12]) and 2) the absorption of light quanta in an atom takes place in two stages which are phase-shifted because of different relativistic effects on the longitudinal and horizontal components of the electromagnetic wave ([14]-[16]). In this theory the local (cosmological) line increment is added periodically (per unit time and then lost again to the non-local universe) on each unit length along the line of sight so at the two extremes of the line of sight it appears either locally as the 'Hubble rate' (H_0) or at the universe's relativistic horizon as a unit length equivalent of the velocity of light. The observer in this geometry can be at either extreme of the radius but not anywhere in between[1]. Since the line increment adds locally to the radius of the universe it can be regarded as a 'crack' in space relative to the plain radius. A phase mismatch during signal absorption may also be regarded as a crack in space and these constitute the conceptual link to the group velocity (which is generated by waves of different frequencies such that the 'energy' and matter by still unknown mechanisms emerges within this frequency mismatch). The geometry (Appendix I) yields a radius which is the inverse of the line increment just described and these are interpreted as, respectively, the radius of the universe, $\overline{q}$, and the apparent local cosmological expansion, $\overline{\Delta q}/ms$ [2] The latter is calculated numerically from the Bohr atom ground state:

$$\sqrt{\hbar} = \overline{\Delta q}\ 2\frac{e\mathbf{C}}{2\alpha}\ \frac{1}{\pi\ Ampere} \Rightarrow \overline{\Delta q} = 7.7145 \times 10^{-27} m/ms. \tag{1}$$

where geometrized units are used throughout while $\mathbf{C}$ is taken as an invariant proportionality factor to make magnetic charge, $ec/2\alpha$ from electric charge. This line increment corresponds to 71.7 km/sec/Mparsec, a theoretical numerical value that has deviated less and less from empirical astrophysical measurements in the past 25 years. One aim of the present paper is to show how this 'crack' in space is related to the group velocity which carries the matter of the electron (and of any other material particle by inference).

Like many times previously in this series of papers one can now lean on the abstract geometry [5] [9] (Appendix I) which strictly distinguishes the local observer of one single spatial dimension from

[1] an observer always finds himself at the center of the universe looking in any direction at its relativistic horizon (or, in the Big Bang scenario, the origin of space and time)

[2] s is used for the geometrized unit of time, a non-standard notation, *sec* for SI-second.

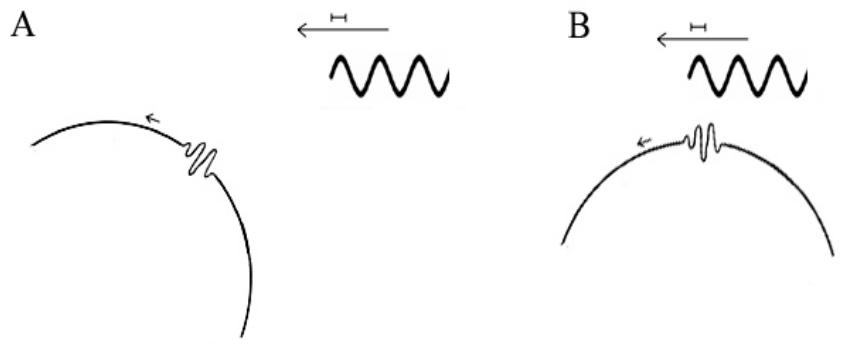

Figure 3: Schematic illustration of an electron in the form of a wave packet orbiting at the atom's surface and interacting with an electromagnetic signal approaching from the right. The picture in B corresponds to the situation described by Eq. 2. Here, the non-local matter and charge inferred by the orbiting electron perpendicular to its momentum axis is optimally situated to interact with the electric field of the radiation.

the non-local observer who is perpendicular to the former's momentum axis. Then one can illustrate the orbiting electron with its momentum along the tangent of the orbit as in Fig. 3. To the electron, its own mass appears perpendicularly and the mass is therefore non-local, a general characteristic of mass demonstrated many times previously in this series of papers[3]. It was shown, for example, that all physical units can be assigned to either the local or the non-local observer whereby not only mass but also time and charge are non-local. Therefore, it is natural to think of the phase modulation in Fig. 3 as both charge and mass moving together. This charge stretches out radially and is capable of interacting with electromagnetic radiation with increasing probability as the amplitude of the latter increases. This is an intuitively acceptable consequence of distinguishing between local and non-local phenomena, which offers a good prospect for replacing the energy level description of emission-absorption with its detailed (at the sub-wavelength level) physical processes. As in the notable case when it can be tracked by relativistic effects [14] the absorption of the electromagnetic wave takes place while the electric field of the orbiting electron and that of the wave cancel (cf. Fig. 3B),

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

a robust physical process that literally encompasses a Lorentz transformation (cf. Appendix I) known from the literature to be composed of a rotation (herein, the electric field) and a boost (herein while the forward-rotated electric field pulls the nucleus with it, conferring momentum). This is fundamentally different from assigning the Lorentz transformation to 'space-time': As the electron continues in its orbit from 'B' in Fig. 3 to the remote side of the atom as seen from the direction of the approaching radiation and the orbit extends into a higher energy level during the absorption the new distance equilibrium between the negatively charged electron and the positively charged nucleus will confer an apparent momentum to the atom. Hence the absorption is a time-extended process wherein the electron's orbit follows the phase of the electromagnetic wave, which agrees with the fact that the

[3]Even in special relativity theory, in its early days, the 'longitdinal mass' was rejected in favor of the 'transverse mass' (cf. [17]

period of the orbit and that of the wave are similar for visible light as discussed in [16][4].

Furthermore, the mechanism illustrated in Fig. 3 is compatible with absorption of radiation having longer wavelength (less 'energy') provided it is contributed with coherent phase (of its amplitude or, say, in popular language, two- or multi-'photon' absorption or absorption of thermal 'photons'). If the absorption were from a point-like particle having a prescribed quantum of 'energy' (a 'photon' particle, that is) the momentum into an extended orbit would have to be transferred to the electron when it is located at the remote side of the atom (cf. Fig. 3 B) and such a quantum exclusiveness of point particles can not be reconciled at all with absorption from lower energies[5]. It must be concluded that the 'quantumness' of absorption derives, not from any photon particles having a certain momentum above a threshold, but more likely from the stability of the electron's orbit in integer numbers of matter wave nodes and antinodes (as in Fig. 1 B, [3], however further elaborated below).

The absorption of relativistically distorted light at a recipients matter-wave interface provides convincing evidence that phase mismatches are at play as argued in the previous papers in this series [15] [16]. Namely, if one re-writes the electric field component[6] of the Faraday tensor as[7]

$$E_y = \frac{1}{\sqrt{1-\beta^2}}(\overline{E_y} - \beta\overline{B_z}) \quad \longrightarrow \quad \frac{c}{v}\overline{E_y} + \overline{B_z} = E_y\frac{c\sqrt{1-\beta^2}}{v} \tag{3}$$

and multiplies with c to get the phase velocity, defined as c^2/v [8],

$$\frac{c^2}{v}(\overline{E_y} - v\overline{B_z}) = \frac{c^2\sqrt{1-\frac{v^2}{c^2}}}{v}\ E_y \tag{4}$$

it is evident that in order for c^2/v to be equal on both sides of the equation [9] either the space-axis has to be Lorentz-contracted or the time-axis has to be dilated. Since the time and space axes are perpendicular (cf. Appendix I) this implies that absorption of relativistically distorted light involves a correction of a phase mismatch between longitudinal and transverse components of the electromagnetic field.

Besides the text-book notion that the abstract relativistic 'space-time metric' is at work here it is also possible to evaluate what kind of concrete physical processes may be involved. Remembering that the electron not only orbits around the atomic nucleus but also has an intrinsic angular momentum indicative of intrinsic rotation of its charge the right side of Eq. 3 stands out as the cotangent (*cosine/sine*) of the angle an orbiting point seems to be delayed to an observer at the origin [13]. This is the key to reinterpreting the 'space-time metric' as a concrete physical process in this case as has already been evaluated in [14] [15] [16] ([18], its p. 7). Above, the factor $\overline{B_z}$ effectuates a (self-canceling) circulation of charge contributing to the electric field, it lacks the factor c/v, and

[4]The ground state Bohr orbit period is $0.152 \times 10^{-15} sec$ while the oscillation period of the radiation being absorbed is $\geq 0.304 \times 10^{-15} sec$, starting at 91nm.

[5]It is well remembered that the energy threshold for the 'photo-electric effect' was *the* argument for a particle nature of light, now made obsolete by observations of multi-'photon' absorption of less energetic radiation

[6]The field component is taken to describe the sinusoidally changing field with all its phases

[7]barred symbols are used for the signal-absorbing observer, unbarred for the emitter (as in the Appendix)

[8]It is difficult to understand why the phase velocity becomes infinite for a stationary object unless examined in a 'Minkowsky diagram' according to [4], its p. 40. If the universe has a finite radius as propounded herein the maximal phase velocity might be that of its radius divided by time, which is nevertheless quite difficult to understand.

[9]The orbiting electron's phase velocity, for example, is $4.10834 \times 10^{10} m/s$, according to the prescription $v_B = c^2/v_{Bohr\ ground\ state}$, which is more than that of light,

disappears upon absorption as described in Eq. 2 so it is not the dominant contribution to the left side and numerically so too, for slow velocities. Any contribution of $\overline{B}$ to $\overline{E}$ may be regarded as 'baked in' for the purpose of simplicity of notation.

In conformity with the construction in Fig. 3 the time axis is chosen as the *sine*-axis, in agreement also with the standard definition of phase velocity as frequency divided by wave number, $\omega/\mathbf{k}$, so the electric field emitted from a relativistically distorted source (un-barred) when determined by the (barred) recipient can be written from Eq. 4

$$\overline{E_y} = \frac{cos\phi}{sin\phi} E_y = \frac{\omega}{\mathbf{k}} E_y \tag{5}$$

This describes how the phase velocity must be changed (herein, its time component, ω) when hitting the absorber in order to avoid a phase mismatch upon absorption. Since the group velocity, defined as

$$v_g = \frac{\partial \omega}{\partial \mathbf{k}}, \tag{6}$$

has the same space-time dimensionality as the phase velocity it too adjusts by its time component.

Then one can turn to the Bohr atom which is still, after so many years, a good physics laboratory with a prospect of generality since besides the hydrogen atom all other atoms too have electrons in their inner shells and the hydrogen atom is likely to have been the first stable matter in the universe. Accordingly, one solves [13] the angle of delay, ϕ, from the electron's Sommerfeld orbit velocity, αc,

$$\tan \phi = \frac{\alpha c}{c\sqrt{1-\alpha}} \tag{7}$$

to obtain $\phi = 0.418111^o$. This raises the question: Can the electron define its forward velocity in its own rest frame? Yes it can, in a looper-like fashion as discussed in [18], it is simply not true that all physical processes have to be placed in an all-comprising checkerboard of coordinates in a 'natural' geometry like nurtured by relativists: The velocity can also be defined as the rate of transfer from a prior adjacent coordinate to a later one, referenced to the local coordinate. From a physics point of view one may also imagine that the electron emerges from its non-local cloud to define its forward velocity, or that it is seen from its center of mass at the atomic nucleus. Furthermore, in the present theory it is the transverse velocity that counts and those are not relativistically impacting along the axis of observation.

The angle just found defines the moment the local part of the electron (its momentum, that is) sees its own non-local matter head on along its momentum axis (somewhat prior to the fringes of group velocity in Fig. 3). This allows it to emerge in arbitrary direction anywhere in its 'cloud' where it alternately takes the form of local linear momentum and angular momentum likely hidden in self-canceling Stokes curl as discussed in [16] and illustrated in Fig. 4. When in orbit in its ground state it is thus capable of redefining its linear 'world line' $360/0.418114 = 861.0149$ times and since its time of orbit is known to be $\tau = 2\pi r_B/\alpha c = 1.5198 \times 10^{-16}$ *sec* this number yields a frequency, $\omega = 5.6653 \times 10^{18} Hz$ and a wavelength, $\alpha c/\omega = 3.86165 \times 10^{-13} m$. This frequency is equal to $2\pi\alpha \times M_e c^2/h$ where the latter three terms are the electron's deBroglie self oscillation ([3], on p. 449) whereas it is related to the Compton wavelength [21] of electromagnetic radiation, $\lambda_C = 2.42625 \times 10^{-12} m$, by $\omega = c2\pi\alpha/\lambda_C$. Might it be possible for the electron to sustain such an energetic oscillation in its everyday whereabouts? The answer may be found in the strength of

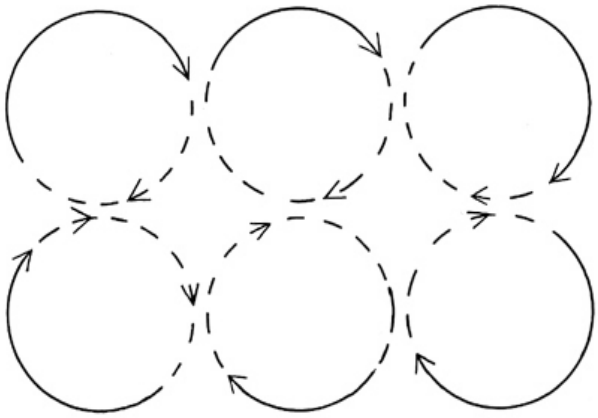

Figure 4: Schematic illustration of the well-known 'Stokes curl' which vanishes in adjacent curl cells and only can be detected at the border facing the exterior. In the case that these curls take place on a sphere (like the atom) there is no outer border and the curls may, in principle, exist forever. In the present theory such curls are thought to represent non-local processes. The nodes of electromagnetic radiation harbor such curls, where they self-cancel, causing the wave to darken.

the nuclear forces, which are strong too, at an even shorter length scale but are energetic enough to generate nuclear reactions. Another known example that short scale phenomena elude human intuition is the transmembane electric fields in biological cells, which are usually in the range of $10^7 V/m$ ($70mV/30 \times 10^{-10}m$), a rather hazardous environment. Therefore, this theory is inferred to be safely workable.

The electron completes a 360^o orbit of redefining its own matter almost an integer number of 861 times but not precisely[10]. This may be the reason it doesn't self- resonate in two dimensions but instead spreads out in its familiar 3-dimensional 'probability cloud', likely a very orderly process unless perturbed from the external environment. Allowing the electron to incessantly redefine itself from its non-local matter as just described is conceptually similar to repetitively exciting it with radiation to prevent its classical Keplerian orbit from deteriorating, a theoretical framework that has been shown to reproduce the electron's probability cloud [19]. In the present theory, it is a natural consequence of identifying a local observer interacting with a non-local one (Appendix I).

Assigning all relativistic effects in signal absorption to the time component[11] of the phase wave defined at the matter - EM-wave interface as just described also provides an intuitively acceptable picture of exactly how these relativistic effects are brought about: When the electron approaches or recedes from the radiation's wave-front its perpendicular matter wave containing its charge experiences a tilt relative to the wave and this tilt is equivalent of a rotation in the electron's own frame of reference. If its local and non-local components were not strictly perpendicular like in the present theory and if this tilt were not important it would start to redefine itself before it has vanished from its prior 1/861 cycle so the two strictly perpendicular frames of observation provide a solid platform

[10]reservation for calculator; α was entered with 7 digits, r_B with five digits

[11]....a conjecture in that mass transforms like time; there is now observational evidence of the longitudinal Lorentz-Fitzgerald contraction [20]

for this (and any other) 'quantum'[12] phenomenon. The tilt may not seem important for an observer in the atom's rest-frame but for the rapidly circulating electron it is. The above arguments of the tilt relative to the wave front and its correction by a rotation also applies in the case that the absorption starts when the electron is at an angle of $\pi/4$ relative to the electromagnetic wave-front as shown graphically in [22] and, since a flattened wave front embodies an equivalent rotation relative to the signal when emitted, it applies to the cosmological redshift as well [10], cf. [11].

Summarizing the above: The electron's various guises in Fig. 1 and its rise from two to three dimensions can be explained comprehensively and the various relativistic effects during signal absorption can also be traced back comprehensively and intuitively (almost mechanistically) to the time component of the phase velocity whereby the interaction between the electron and the EM wave also can be followed in an intuitively appealing way. But that is not all, one has actually just now pushed open the door to the concrete inner workings of all physical processes that transform like mass and have been hung and hidden for 100 years in the abstract mathematical coordinate network of relativity theory.

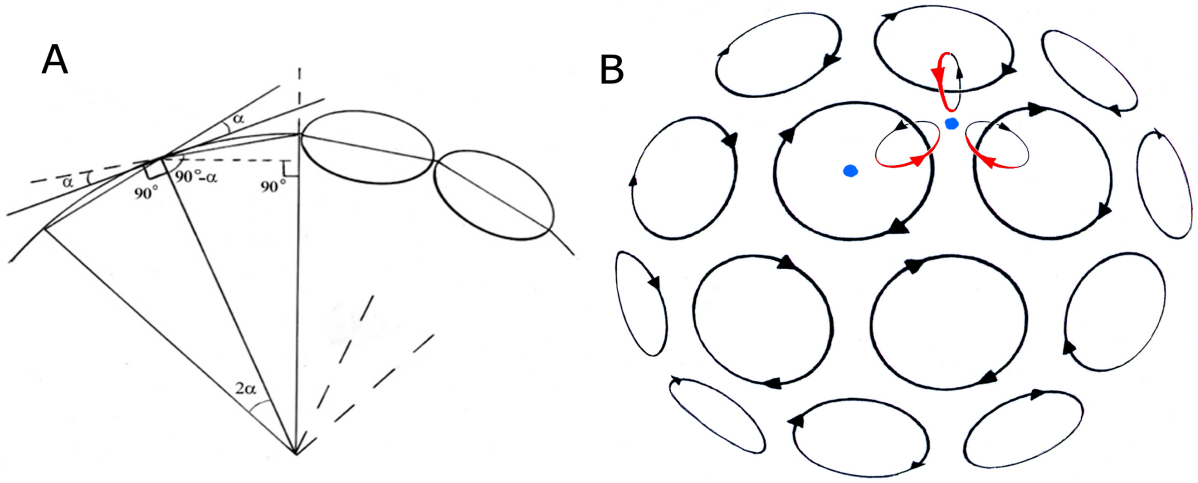

Figure 5: A. Geometrical construction to obtain the diameter of the Stokes curl cells surrounding the 'momentum rider' assuming that the angular delay of observing the orbiting point as described by Eq. 7 is compensated precisely by the curvature of the (average) electron cloud. This angle is seen in the sketch to be α. The apex angle of equilateral triangle cutting the diameter of the curl cells is $180 - 2(90 - \alpha) = 2\alpha$ and the sought diameter can be obtained from Pythagoras' theorem as $\sqrt{(r_B - r_B cos2\alpha)^2 + (r_B sin2\alpha)^2} = 7.723 \times 10^{-13} m$. In sketch B, such curl cells are stretched onto a sphere of very much exaggerated curvature to show two possible positions of the momentum observer (blue dots) within the circulation of negative charge (black circular arrows at the surface of the sphere) and the magnetic field induced by the charge circulation (red ovals). The diameter of the curl cells was calculated in A to be $7.723 \times 10^{-13} m$.

In classical theory, e.g. [23], the fine structure constant, α, is given robustly[13] by

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c} \Rightarrow \alpha = \frac{\mathbf{K}e^2}{\hbar c} \tag{8}$$

[12]'quantum in its original sense of 'indivisible', in the referral literature almost everything is 'quantum' these days.

[13]cf. 'Wikipedia article on the subject while herein avoiding the vague notion of 'energy': e = charge of the electron, ϵ_0 =permittivity of space, $\hbar$ = Planck's constant divided by 2π, c = velocity of light, H_0 = the apparent cosmological expansion in the local universe

where the constant $\mathbf{K} = 7.4246 \times 10^{-35}$ incorporates ϵ_0 and the conversion into geometrized units from SI-units, cf. [23]. Inserting this value of α into the squared Eq. 1 yields

$$\alpha = \frac{\overline{\Delta q}^2 \mathbf{C}^2}{\mathbf{K}\pi^2 Amp^2}, \tag{9}$$

thus,

$$\mathbf{C}^2 \overline{\Delta q}^2 = \mathbf{K}\alpha\pi^2 Amp^2, \tag{10}$$

a result which quantitatively links the group velocity represented by α to the 'crack' in space, $\overline{\Delta q}$, eqv. of H_0. Herein, the constant $\mathbf{K}$ only converts the units (as far as one knows, at least) and the constant $\mathbf{C}$ may have some physical significance yet to be clarified but α is no longer a constant: Now it performs a function, namely it relays a string of *accelerations* of magnetic field (induced by the circulation of charge, $\pi \times Ampere$) and this is proportional to $\overline{\Delta q}^2$. The moment of maximum change of magnetic (or electric) field is when the wave embodies the most rapid change of momentum as discussed in ([16], its p. 4) (similarly to a Newtonian force causing change of velocity or acceleration becoming noticeable, cf. [24]). In addition to Eq. 10, α can be numerically linked to the Stokes curl cells and the Bohr radius with the help of Fig. 5. Simply dividing the Bohr radius, $5.292 \times 10^{-11} m$ by the radius of the curl cell, r_Z, yields the number $1/\alpha$. The link with acceleration of magnetic flux is evident by multiplying both radii by 2π and comparing with Fig. 5B: While the electron orbits one turn the magnetic flux too orbits an equivalent distance, r_Z/α, in the curl cells. Thus the flux exhibits a continuous acceleration (while rotating) which is different from projecting its rotation onto a Cartesian axis in another frame of reference. While the integer 137, much sought for in previous scientific endeavors, could not be found here either the number $1/\alpha$ relays another integer at another pitch ($n \times r_Z$) as just described - the electron comes with a ruler and a scale.

One might ask where the wave is in such a pattern like in Fig. 5B. The answer is of course that it *is* the wave. Projecting these curls along their planes onto a straight line gives two sinusoidal-looking waves perpendicular to each other. Even though the frequency of the electron's self-oscillation is too high for generating its observed matter wave the plaited Stokes curls establish a foundation for its non-local whereabouts from where it may emerge in some form or another depending on a suitable resonance or environmental perturbation - the mystery of its many faces (Fig. 1) has been solved, in principle at least, establishing a foundation for more detailed analysis.

The size of the electron's founding curl cells, r_Z, was determined by plain geometry assuming that it sees a 'Maupertusian', cf. [3] [4], linear world consistent with the founding theory (Appendix I). Whether or not this is reasonable can be evaluated by solving its classical radius, $r_e = \alpha^2 r_B$ using $r_Z = \alpha r_B$ from Fig. 5, [14]

$$2\pi r_e \frac{137}{2} = \pi r_Z : \tag{11}$$

While a full orbit in the curl cell made the electron non-local (Fig. 5B) half a turn only like in Eq. 11, and not more, defines its local circumference (right side). This promising result agrees with the gist of Stokes curl wherein counter-current fluxes cancel everywhere except at a boundary. So, the electron can materialize from its non-local world after half a turn in a curl cell, which happens to be where magnetic monopoles also may appear ([25], esp. its p. 70), similarly (without curl cells or

[14] in blue: Jan. 20, 2025

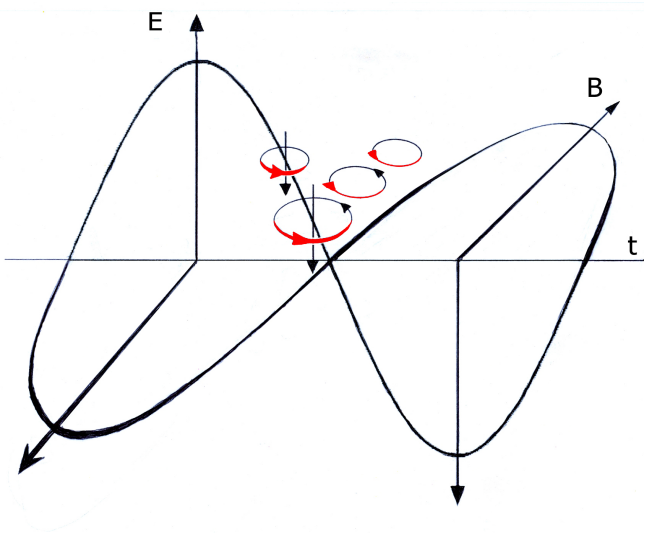

Figure 6: Illustration of a wavelength of electromagnetic radiation like in textbooks indicating in addition with downwards arrows the anticipated movement of negative charge when the electric field changes direction. This movement of charge has a maximum at the nodes of the wave. Since moving charge is always surrounded by magnetic curl there must be such a curl (red arrows following a closed circle) but any such cell of curl is canceled by adjacent ones in the wavefront, which should contribute to the node being dark.

graphics) invoking the number 137/2.[15]. It remains to be emphasized that the 'plaited' structure of the electron's orbit is not to be taken literally, it is just a mechanism with good standing in physics that makes the electron non-local. The orbiting electron is the best known room-temperature superconductor, the paired valence electron an even better one, and superfluidity with all its attributes such as zero viscosity is expected here since the non-local electron's matter is elsewhere.

Then turn to the electromagnetic signal (Fig. 6) keeping in mind the unimaginably high phase velocities of particles at rest or almost at rest. The aim is now to apply the description of non-locality in Fig. 5B to the wave-front of the signal for the purpose of coming to grips with instantaneous (non-local) phenomena in signal transmission. The nodes of the wave is where the electric and magnetic fields change most rapidly as illustrated for the electric field in Fig. 6. This is equivalent of a current (negative charge moving downwards in the drawing). Since linear currents are surrounded by circular magnetic flux the wave-front at the node can be thought of as a surface of such flux cells, just like in Fig. 5B.

In order to sustain the wave moving forward on its momentum axis all these curls have to be in (anti-)phase. It doesn't matter if the movement of charge and magnetic curl is canceled within the wave (which makes the nodes dark) its 'energy' can not simply disappear at the nodes. However, by analogy with Fig. 5B it can oscillate between a local and a non-local form. When it emerges in a local form somewhere in the wave-front it carries with it its phase information of frequency, angular momentum and, possibly amplitude. If such phase information is lost at one location in the wave-front (absorption taking place) phase coherence requires that it is lost everywhere in the wave-front at some characteristic very high velocity ($v \geq c$), reaching instantaneous communication if the one

[15]in the present theory the monopole is assigned to the local world by frame signature

chooses a stationary absorber for reference. The gist of this description is that the phase of the wave 'picks' the 'energy' of its signal from some non-local whereabouts. This enables non-local phenomena in signal transmission and explains why they appear to be instantaneous. - It is an idea that should be easy to accept in contemporary relativity physics where electromagnetic radiation does not have mass. It is tempting to infer in addition that non-local mass too (dark matter, galaxy halos, etc, in, say, a matter field or 'Higgs field', or, why not; a boson field [11]) operates by the same mechanism. If that is so, then all matter is purely non-local and manifests itself primarily *via* its momentum generation, not by 'stone-age' friction against the matter field but by 'caging' the matter in some local phase geometry yet to be conceptualized some time in the future within the 'topology' of various elementary physical processes.

If one stays with the above less hypothetical picture of signal transmission, it too is of course somewhat awry in the context of the generally accepted notion that the radiation is carried by photon particles. But, the photon particle description is in trouble anyway, especially in its context of SRT: It is often claimed in the literature that apparently instantaneous signal transmission does not transfer information or energy so SRT is right anyway. However, instant transfer of phase information surely is a kind of communication and the radiation's 'energy' goes with it. This is very difficult to explain based on mainstream physics concepts but in the present theory as just outlined, it is intuitively acceptable.

Furthermore, recently described phenomena in advanced optics such as time-coincident absorption [26] of entangled 'photons' (herein phase components) seem to be possible to understand on the basis of the phase coherence model of Fig. 3B and Fig. 6. Namely, when the absorption takes place simultaneously at two locations the phase within the wave-front must be identical at these locations.

In the present theory with reduced number of dimensions the squared line increment, $\overline{\Delta q}^2$, can be interpreted as angular momentum (e.g. [18], its p. 7)[16] or classical 'action' Et ([11], its p. 7) and the line increment has been linked quantitatively to the masses [11] [27] and the half lives ([11], its p. 7) [27] of the resonance bosons and the electron's orbit velocity (herein and in [27]) besides mitigating the so called 'Hubble tension' in astrometry [10] [22]. It is rather unlikely that all these numerical results are algebraic trivialities derived from using the Bohr ground state in Eq. 1. Furthermore these results were all obtained by challenging the founding theory (Appendix I) for self-consistency and 'physicality', herein also re-shaping the electron. It is is unavoidable to conclude that the line increment is very important but also fun to contemplate some general 'philosophical' -etc. implications:

3 Some Metaphysical Excursions

The present results of examining the electron support the notion propounded in the previous papers in this series that there is a continuous shredding at the edge of the universe onto the fringe of one unit local length. This 'fringe' is argued to be equivalent of the local apparent cosmological expansion carrying an equivalent amount of geometrized mass, part of which is observed as local

[16]The frame signature in the present 2-dimensional theory of angular momentum defined as $L = 2\pi M\nu r^2$ has dimension m^2 (m=meter) since mass (numerator) and time (denominator) cancel. Furthermore the line increment per unit time is equivalent of a velocity and the squared velocity herein has the same dimensionality as linear momentum.

mass but most of which is still in the form of non-local mass. This is not a mainstream interpretation in physics[17], neither is the notion herein that relativistic distortions are evidence of actual physical processes and not some kind of 'divine'[18] space-time geometry. Since talking about a fringe like above is just another way of saying that this world is garbage thrown from a perfect world, now proved with mathematics, then, if not every scientist, every doomsday preacher and every political extremist in every nook and corner will probably agree. Even though they appear to have been right all the time if one adopts this world picture their arguments are void nevertheless since the momentum world is always going to be base.

It is more promising to explore its time component. To do so, follow the electron while it establishes its place in its probability cloud. Wherever it looks it will see reminiscences of its possible whereabouts. Since it self rotates too, these flushes of light will appear to come from every direction of its spherical world, not just from its 'shell' where it orbits when looked at in the laboratory perspective. This non-locality of whereabouts is at the heart of the path integral description of quantum phenomena in physics - calculating all possible paths (energies) and adding, an approach probably first ever applied to the Helium atom. Likewise, the Terrestrial observer looking at the stars (telescopes allowed) will at any instant see signals coming from any direction and depth in the universe while the actual emitting objects have disappeared from their apparent locations long ago. The sight is just a mirage of signals, providing convincing proof of the non-locality of time and one can be certain that among all these signals from any depth and epoch there is also a reminiscence arriving from the origin of space and time at the opposite edge of the universe. One way to calculate this reminiscence has been explained previously in this series of papers.

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[17] Namely, in contemporary astrophysics the line increment is thought to be a literal expansion of space and the universe is thought to expand like a balloon being blown up, appearing like a 'raisin cake' rising in the heated baking oven.

[18] 'divine' in the sense that 1) the geometry of special relativity theory knows ahead of time the relative velocities of any observers, like an almighty 'God', 2) concrete things are projected onto an all-comprising abstraction and 3) it has its prophets. Even though relativity theory appears to be a good mathematical tool, the versatility of its Lorentz transformation prohibits its universality. One may, for example, use the Lorentz transformation to recast it in terms of rotations such as in Eq. 4 and 7

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4 Appendix I, Abstract Theory (from [5], see also [6], [9]

The instant of observation has a special significance in the quantum world since it accommodates the processes that cause the quantum observer to change from the ignorant state to the observed state. One approach to characterizing the instant of observation is to perform a Lorentz transformation of the inverse of the number-flux vector at discrete time coordinates -1 and 0 defining an interval of observation:

$$(q_0, t_0) = \left(\frac{\sqrt{1-\frac{v^2}{c^2}}}{v} \frac{m^2}{s}, 0 \right); \qquad (\overline{q}_0, \overline{t}_0) = \left(\frac{1}{v} \frac{m^2}{s}, -s \right) \tag{12}$$

$$(q_r, t_r) = \left(\frac{\sqrt{1-\frac{v^2}{c^2}}}{v} \frac{m^2}{s}, s\sqrt{1-\frac{v^2}{c^2}} \right); \qquad (\overline{q}_r, \overline{t}_r) = \left(\frac{1}{v} \frac{m^2}{s} - vs, 0 \right) \tag{13}$$

$$\overline{\Delta q} = -vs \ , \qquad \overline{\Delta t} = \overline{t}_r - \overline{t}_0 = s \quad \Rightarrow \frac{\overline{\Delta q}}{\overline{\Delta t}} = v \tag{14}$$

$$\Delta q = 0 \ , \qquad \Delta t = t_r - t_0 = s\sqrt{1-\frac{v^2}{c^2}} \ . \tag{15}$$

Here, m is the unit of length and s the *geometrized* unit of time [19]. This system of equations defines two observers located at the origin (un-barred) and at radius distance from the origin (barred observer). The latter observer is capable of observations along the momentum axis, $\overline{\Delta q}$, and of measuring the unit of time while the observer at the origin only is aware of time and recognizes an angular velocity v. The two observers are space-like separated.

The directions of the axes is defined by analogy with the unit circle, $(\cos x)^2 + (\sin y)^2 = 1$, as

$$q_r{}^2 + \frac{1}{c^2}\frac{m^4}{s^2} = \frac{1}{v^2}\frac{m^4}{s^2} = \overline{q}_r{}^2 \tag{16}$$

or

$$(\frac{\Delta t}{s})^2 + (\frac{\overline{\Delta q}}{m})^2 = 1 \tag{17}$$

so that line increment and time interval are perpendicular. The time interval measured by the momentum observer is also perpendicular to the momentum frame where it defines the tangential velocity as shown in eq. 14c.

The sign of the line increment (cf. eq. (14) shows that the radius of the observed object decreases. This corresponds to the observer at the origin computing a contracted radius $\overline{q}_0$ similarly to the Fitzgerald case, $q_0 = \overline{q}_0\sqrt{1-v^2/c^2}$. Hence, the geometry can be understood as a circle space-like separated from a peripheral observer who detects it in the form of a line increment in the direction of observation (equivalent of a contraction of its radius) after the passage of one unit of time. Furthermore, the axis of linear momentum may also be thought to harbor axial vectors. In physics, line increments in the direction of observation are known from the Bohr atom and the cosmological expansion.

For observations towards the origin along the radius, the magnitude of the line increment is amplified from $\overline{\Delta q}$ per unit radius to the unit length, m (this may also be seen from eq. (12b) and (14a)),

$$\frac{-\overline{\Delta q}}{m} = \frac{m}{\overline{q}_0} \ , \tag{18}$$

[19] using non-standard (not SI) notation for the purpose of distinguishing the two units

which yields

$$\overline{q}_0 \ \overline{\Delta q} = -m^2 \approx \overline{q_r} \ \overline{\Delta q} \quad , \tag{19}$$

whereby the velocity of light, m/s, limits the radial extension of the geometry to $|\overline{q}_0|$ ($v \leq c$ as required by $\sqrt{1 - v^2/c^2}$). Because of eq. (14) and (15), observations can only be made from the laboratory frame at the periphery towards the origin of space and time coordinates. The observer at the origin is non-local in the sense of performing all observations solely on the time axis (eq. (15b)) and can only access the observation *via* eq. 17.