Exploring the Nuclear Physics of Factorizing the Planck Length *

Erik A. Cerven*

**www.scienceandresearchdevelopmentinstitute.com*

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Abstract

The Planck length is factorized in terms of the apparent local cosmological expansion rate and magnetic charge and inserted into the energy quantum, $h\nu$. This transforms the force equilibrium of the Bohr ground state into a geometrical object which is interpreted as a sphere surrounded by circular currents; a nucleus surrounded by an electron cloud. In this atom, the apparent cosmological expansion rate, the W boson's mean life and the orbiting electron can be related numerically to be engaged in a resonance. The charge shadow on the nuclear surface of the orbiting electron is followed in terms of quark charges, appearing as a proton, a neutron and a pion with the stable particles appearing at the electric field antinodes and the unstable pion at the nodes. This is analogous to the electromagnetic radiation where the field at the antinodes is local whereas the nodes are invisible but expected in the form of non-local (cancelling) circular curls. Also the separation of a nonlocal and a local event in signal absorption as theorized previously has a correspondence in the present case: Local and non-local terms are identified making it possible to relate numerically the apparent Hubble rate to the mass of the W-boson in terms of geometrized energy. Since the cosmological line increment is invariantly obtained from the units of length and time the particles are scaled as well, which brings in the deBroglie particle oscillations. Finally, the concept of 'energy' is scrutinized. The adopted geometry comprising a local observer connected by Lorentz transformations to a non-local (perpendicular) observer allows the physical unit of energy to be dissected into physical processes in terms of these observers.

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1 Introduction

This paper is a continuation of almost 25 years of work based on the foundation that 1) the apparent cosmological expansion rate, the so called 'Hubble constant', can be derived by factorizing the Planck length and 2) a geometry comprising an observer of linear momentum connected by Lorentz transformations to a perpendicular, 'non-local' observer provides a natural framework to the physical world. In this theory, the local Hubble apparent expansion rate, a line increment equivalent of geometrized energy, is a constant of nature profoundly involved in atomic processes, envisaged to regulate resonances at the level of elementary particles and to determine geometric properties of the atom as well as of the entire universe. The adopted geometric framework reinforces these interpretations of the apparent expansion rate while preserving the time dilatations of relativity theory. It leads to physical units being assigned to either the local or the non-local frame of observation such that the geometry *per se* provides guidance about what kind of physical processes take place just by rearranging terms into local *versus* non-local. The latter method has, for example, been successfully applied to the Schrödinger equation and the Planck thermal distribution. More recently, it has been applied to Maxwell's equations in their Faraday setting whereby the non-local observer takes the position in the center of curls at the wave-nodes while the local observer is in the field maxima at the antinodes. This leads, *inter alia* to the emitter being local at the signal source and the receiver of the signal being non-local in the 2-dimensional wave front but when catching the signal performing a rotation within the wave node that brings forward 'locality' as the wave proceeds from node to antinode. The latter leads to 'relativistic effects' being assigned to the correction of a phase mismatch between the non-local and local parts of the wave, a correction that takes place physically at the wave-matter interface. In the present theory this concrete physical process replaces the notion in relativity theory that a 'natural' geometry knows ahead of time the relative velocity of emitter and signal absorber. Studying the behavior of an electron subject to these conditions shows it to be capable of mediating 'relativistic' time dilatation when observing a signal from an emitter approaching or receding: By tilting its angle of reception of the frequency of the signal the electron is capable of correcting a phase mismatch between transverse and longitudinal components of the electromagnetic wave whereby the absorption process starts at the non-local signal node and terminates at the local antinode where the fields are maximal. This notion hints at the possibility that the cosmological redshift arises as a consequence of the electron's rotation (eqv. angular momentum) and not because of any literal expansion of space [1].

Against this background the purpose of the present paper is mostly to bring forward the behavior of the atomic nucleus under these conditions aiming at understanding the origin of its mass. Most of the results presented here can be regarded as a synopsis of previously published results, now however in a more comprehensive setting and adding the factorization of the Planck length within the quantum itself, $E = h\nu$, followed by the geometry-prescribed rearrangement of terms. The latter leads to convincing evidence of circular processes taking place on the surface of a sphere, which is corroborated by also rearranging matter waves in terms of the prescribed local-nonlocal geometry. The circular processes are sought in the charge shadow on the surface of the atomic nucleus of the orbiting electron in its ground state and detected in the form of quark charge resonance. This brings in the W boson, which has the capability to interact with quarks, yielding numerical evidence that it is related to the cosmological apparent line increment. In summary, this investigation touches on several important problems in physics like the cosmological expansion rate, the proton radius, etc. and shows that a comprehensive 'interdisciplinary' approach can be advantageous compared to focusing isolatedly on each separate topic. It leads to 'predictions', subsequently confirmed, of the numerical value of the local Hubble expansion rate and the W boson mass.

2 The Proton Radius

The contemporary endeavor to determine the proton's radius is founded on the tacit assumption that it truly is a particle with well determined boundaries like any classical object. Is that really so, is it like a grain of sand in a sandbox and if yes, what defines its boundaries? Ever since the existence of an atomic nucleus was inferred 110 years ago by its effect of scattering a fraction of a beam of particles [2] scattering studies have been the preferred means of determining its radius. Direct scattering from protons is sometimes possible or else, one may extrapolate its radius from other nuclei using that the scattering radius is proportional to the cubic root of the mass number. The cubic root proportionality is also found in size determinations based on α-particle decay. Scattering is nowadays carried out with increasingly energetic particles that penetrate deep into the nucleus, something which highlights that in order to claim to have a particle one has to know its boundaries. An alternative way of establishing that something is a particle is by reference to a circular orbit, like in the case of the atom's orbiting electron, which defines the atom's boundaries. This method has the advantage over scattering that it ascertains the particle has some persistence and does not just appear and disappear at the moment of scattering. Especially, phase locking in the orbit may render a particle *durable* [3]. Furthermore, plain theory may hint at the existence of a particle. For example, a phase-mismatched wave's 'group velocity' has been linked to the concept of a moving particle having some 'energy' but in this case the particle's dimensions or its boundaries are not given. Also the present theory provides a tentative value for the proton radius based on the inverse lengths embedded in its geometry. Some values of the proton's radius obtained by these methods are given in Table I and it is obvious that the results depend on the method chosen. Surely all these experiments were made with impeccable scrutiny so one may infer that no-one is ever going to be right about the proton's radius, at least by targeting it directly.

Table I

Method	Refs.	Value
Charge radius (e.g. electron scattering)	[4] [5] [6] [7]	0.88fm
Vector meson photoproduction	[8]	0.67fm
Extrapolating to A=1 using elastic α-particle scattering	[9]	1.414 fm
Extrapolating to A=1 using neutron (wave) scattering	[10]	$\geq$ 1.37fm
Extrapolating to A=1 using radius-dependent thresholds for α-particle decay of unstable nuclei	[11]	1.48fm
From plain theory in the present geometrical framework	[12] [13]	1.439fm

Some numerical values of the proton radius obtained through the years.
The extrapolations can be done in the graphs of the published papers.

However, one of the methods above [11], the radial distance threshold for release of an α-particle during radioactive decay, introduces the natural environment in the nucleus as an indirect path to finding the proton's radius. The importance of the proton's (and any nucleon's) natural environment is easily realized by considering the effect of charge attraction in the atom as opposed to bombarding it with electrons as illustrated in Fig. 1. Because of charge effects one may reasonably expect that its radius is longer in its natural environment surrounded by orbiting electrons pulling its charge

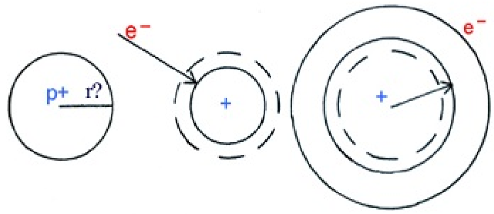

Figure 1: Schematic illustration of a proton (left) and how its apparent radius may shorten when impacted by electrons (center) or lengthen when pulled out by the negative charge of an orbiting electron.

outwards compared to the radius obtained from the scattering of impacting electrons.

It is also possible to infer the proton's radius by subjecting the atom to the strict requirements of some abstract geometry. The present approach, which will be further pursued herein, has been to implement the inverse lengths that are defined in the geometry constituted by an observer of linear momentum surrounded by a non-local observer perpendicular to the momentum axis [12] [13]. Tentatively,

$$\frac{2a_0}{2\pi\ 1m} = \frac{2\pi\ \overline{\Delta q}}{2r_p}\ . \tag{1}$$

In Eq. 1 two rounds of a circular process (the factor π) takes the diameter back and forth once, alluding to the 'spinors' of the 'Dirac Equation'. Two rounds on the circle also makes a physical process shuttle back and forth 8 times between the perpendicular local and non-local axes. In Eq. 1 the electron's orbit (a_0) is referenced to the velocity of light ($1m/s$)[1] while the proton's radius is referenced to the cosmological line increment $\overline{\Delta q}/ms$. The unit length will be the distance light travels while the line increment takes place (more precisely, while it oscillates between the local and the non-local frames) which assures the terms are scaled. In this theory, which defines inverse lengths [12] [13], the line increment interacts with the nuclear matter while the light signal interacts with the electron as usual. This justifies regarding the radii in Eq. 1 being contributed by circular processes.

The numerical value of $\overline{\Delta q}$ above is obtained by factorizing the Planck length as [2]

$$\sqrt{\hbar} = \overline{\Delta q}\ 2\Big(\frac{ec}{2\alpha}\Big)\ \frac{1}{\pi\ Ampere}\ ; \qquad \overline{\Delta q} = 7.714 \times 10^{-27}\ s^{-1} \tag{2}$$

which[3] yields a proton radius of $1.439 \times 10^{-15}\ m$, reasonably close to the neutron scattering and α-particle decay values in Table I. Although it is well established that the Bohr ground state electron orbits the nucleus more or less circularly, excited states of most atoms do generally not so the geometrical shape of the un-perturbed proton and the nuclei in stable matter may not necessarily be

[1] non-standard notation: s is used for geometrized time, sec for time in SI-units

[2] $\hbar$ = Planck's reduced constant, e = unit electrical charge, c=numerical value of the velocity of light in SI units, not being geometrized here because of charge invariance within the magnetic charge, $ec/2\alpha$, α = fine structure constant $\approx 1/137$

[3] This numerical value corresponds to 71.36 km/second/Mparsec, which is within the range of contemporary astrophysical measurements [14] [15]

spheres, especially considering that the nucleus is much more complicated than the 1:st Bohr orbit. However, the following analysis favors the shape of a sphere.

3 The Spherical Environment of the Energy Quantum, $h\nu$

By using Eq. 2 for substituting Planck's constant in the quantum, $\Delta E = 2\pi\hbar\nu$, one gets, depending on where one puts the number 4;

$$4\ \overline{\Delta q}^2\ \pi\ \overline{Q}^2 = \frac{\Delta E}{2}\ (\pi\ Ampere)^2\tau\ , \tag{3}$$

$$\overline{\Delta q}^2\ \pi\ \overline{Q}^2 = \frac{\Delta E}{2}\ (\frac{\pi}{2}\ Ampere)^2\tau\ , \tag{4}$$

or

$$\frac{\overline{\Delta q}^2\ \pi}{4}\ \overline{Q}^2 = \frac{\Delta E}{2}\ (\frac{\pi}{4}\ Ampere)^2\tau \tag{5}$$

where $\overline{Q}$ is the unit of magnetic charge,

$$\overline{Q} = \frac{e\ c}{2\alpha}. \tag{6}$$

and $\tau = 1/\nu$ is the oscillation period of the signal, $h\nu$. These equations show clear evidence of the geometry of a sphere; the term $\overline{\Delta q}^2\pi$ on the left side is the surface of a sphere and the term $\pi\ Ampere$ on the right side hints at circular currents. Furthermore, the magnetic charge (or two of it) is naturally embedded in the geometry such that it can be intuitively understood to arise at the origin surrounded by tangential currents in arbitrary directions[4]. There is no doubt that Eqs. 3 - 5 depict a particle. The magnetic charge has previously been conjectured to be related to the proton [16] and so has the line increment, $\overline{\Delta q}$ [17], the latter quantitative results will be revisited and extended in Chapter 5 herein. Moreover, in Eqs. 3 - 5, local terms have been gathered on the left side and non-local ones on the right side as prescribed in this geometrical framework [18] [19] [20]. Since the nucleus appears more local than the notoriously non-local electron cloud, it is reasonable to conclude that the equations above describe an atom, not surprisingly since Eq. 2 was derived from the ground state Bohr atom. However, applying Eq. 2 to the quantum transforms the force equilibrium of the Bohr atom into a geometrical object as specified above.

All the terms above except the 'energy', $\Delta E/2$, can be given a physical meaning. In the Bohr theory only the potential energy participates in absorption-emission so the kinetic 'energy' remaining in the atom must be hidden in the other terms above. This brings forward the ambiguity of the concept of 'energy', however: From a historical perspective the concept of 'energy' likely developed from the earlier 'phlogiston' theory of the early 18:th century whereby the phlogiston substance was simply renamed and granted the privilege of not having to be a substance at all while still retaining its ambiguous character of popping up anywhere. The best one can say about 'energy' in physics is that it acts like money in economics but just like the money in society which merely catalyzes

[4]...an interesting conclusion *per se*, since the whereabouts of magnetic charges long has been discussed and even their existence have been cast in doubt...

economic activity there, it has nothing to do with the concrete physical processes taking place. Eqs. 3 - 5 offer an opportunity to test this idea in order to once and for all put a lid over 'energy' - the ugly Medusa monster still roaming around in modern physics.

For this purpose, consider the mysterious 'group velocity' known in the literature to be the velocity of a particle, alternatively its energy, but nevertheless failing to confer any sense of a concrete substance, which is what is required of a particle. The group velocity may be defined as [21], p. 61 therein.

$$U = \frac{dq}{dt} = v = \beta c = \frac{dE}{dp_x} = \frac{d(h\nu)}{d(h\frac{\nu}{V})}; \qquad V = \frac{\omega}{k} \tag{7}$$

where V is the phase velocity, ω the angular velocity and k the wave number, or simply (from the right side above)

$$U = \frac{\delta\sigma}{\delta k} \tag{8}$$

where $\delta\sigma$ is the change of number of oscillation periods per number of wavelengths δk. Is there any way that a plain time-less number can bring forward a particle? This interesting problem will be addressed in Chapter 7. First however, consider the de Broglie matterwaves and rewrite them in conformity with the herein adopted geometry [13] [22] consisting of a local observer of linear momentum and a non-local observer:

$$\Lambda_{dB} = \frac{2\pi\hbar}{m_e\ v_e}\sqrt{1-\frac{{v_e}^2}{c^2}}; \qquad (\Lambda_{dB}\ \nu_{dB} = v_e) \quad \rightarrow \tag{9}$$

$$\overline{m_e\ v_e} = \frac{h\nu_{dB}}{c}\ \frac{c\sqrt{1-\frac{{v_e}^2}{c^2}}}{v_e} \quad \rightarrow \quad \overline{m_e\ v_e}\ sin\ \alpha = \frac{h\nu_{dB}}{c}\ cos\ \alpha \tag{10}$$

Eq. 9 introduces the electron's wave velocity in terms of its wavelength and frequency. Furthermore, by using in Eq. 10 that

$$tan\ \alpha = \frac{v}{c\sqrt{1-\frac{v^2}{c^2}}} \tag{11}$$

is the tangent of the angle that a rotating point seems to be delayed when viewed from the origin (known from stellar 'aberration') one obtains the result that the local observer sees the $cos\ \alpha$ projection of a physical process and the non-local observer sees its $sin\ \alpha$ projection, indicating once again a circular or spherical geometry. This was of course already known by fitting the electron's matter wave to the Bohr ground state radius-circumference but Eq. 10 hints at a more general significance in terms of geometry. So there are now three lines of evidence of a circular-spherical geometry, Eq. 10 and the left and the right sides of Eqs. 3 - 5, which is a good starting point for examining a particle's boundaries, herein the proton's radius, the scope set out in Chapter 2.

The proton's radius is important since it determines the velocity by which the orbiting electron casts a charge shadow on its surface. This will be examined now.

4 Charge Oscillations in Terms of Quarks

It is known that 'quarks' only can be observed at high energy collisions between particles, mostly nuclei, but that does not preclude that quarks also exist at low energies in stable matter. In stable matter, the first generation quarks, u and d, would contribute dominantly. The purpose of this Chapter is to evaluate further (as in [17] and [18]) if the orbiting electron might induce dipole oscillations on the nuclear surface that would resonate with oscillating quark charges if such take place. This problem can easily be solved graphically as shown in Fig. 2 assuming that a proton is represented by quarks $u\ d\ u$, the neutron by $d\ u\ d$ and the pion by $u\ \overline{d}$ or $d\ \overline{u}$. The graphs show that the stable proton and the neutron would appear at the electric field maxima and the unstable neutral or positively charged pion at the field nodes (Fig. 2A). Especially the π^+ appears to thrive together with the neutron, somewhat reminiscent perhaps of the electron which seems to exist as two particles with its charge separate [23] [24] [25]. However, the negatively charged pion can not be distinctly assigned to any of these two locations (Fig. 2B). Thus, besides the charge compatibility with perpendicular dipole oscillations taking place on the nuclear surface (in the wake of the orbiting electron) yielding a proton, a neutron and a pion (the essential components of a stable nucleus) the quarks naturally arrange themselves such that the nucleus is positively charged and the stable matter appears at the local antinodes and the unstable matter (the pions) appear at the non-local nodes[5]. Recall from [18] the context of Fig. 2 (edited quote):

The proper context of Fig. 2 is the discovery of two magnetic monopoles in Planck's constant (Eq. 2) since quarks have been theorized to be confined by two monopoles [26] [27] and the latter were originally conjectured to be related to the proton [16]. Consequently, the atom having its putative mass-providing quark dynamics at its center can be viewed as two radiating monopoles of opposite charge, largely charge neutral but, nevertheless capable of oscillations generating small magnetic dipoles. Since the quarks have very short range of interaction they can not be expected to interact beyond their nearest neighbors as illustrated schematically in Fig. 3. Here, the proton, constituted by *u, d* and *u*, is stabilized by interacting with its dual, the neutron, constituted by respectively *d, u* and *d*. There is only one nearest neighbor-configuration of such a dynamics, the one illustrated in Fig. 3. Here, 1/7 of the total resonance at play in one proton (in equilibrium with a neutron) is available for each quark-quark interaction. Alternatively, in Fig. 4, the available resonance is divided by 3 as in the case of the proton and the neutron.

Since it is known from electro-weak Z-production in proton-proton collisions that the W-boson couples to *u*-*d* pair color exchange (Fig. 1 in ref [28]) it is reasonable to assume it is capable of acting as a proxy for the gluons. In the Standard model the latter are thought to be mandatory for dynamics in higher quark symmetries than what applies to stable matter. The W boson and the gluon have the same spin while the charge of the W-boson in comparison to the neutral gluon should actually make it better fit for interacting with the charged quarks. The W-boson is too heavy to be seen in stable matter but fractions thereof (in terms of mass) may nevertheless exist there, it is just a resonance anyway. The out-of-equilibrium theories of mass generation involving symmetry breaking etc. may guide but not dictate the particle dynamics of stable matter allowing some freedom of imagination. In such a case, when there are no accelerator proton-proton collisions, from where does the W or a fraction thereof get its internal 'energy' - its equivalent mass? It has previously been shown

[5] 'Local' and 'non-local' are used here in the same sense as in the case of electromagnetic radiation where the electric and magnetic field maxima (antinodes) appear in the local 'laboratory' frame whereas the nodes are invisible, known nevertheless to be characterized by curls (canceling or not) surrounding the rapidly changing electric and magnetic fields.

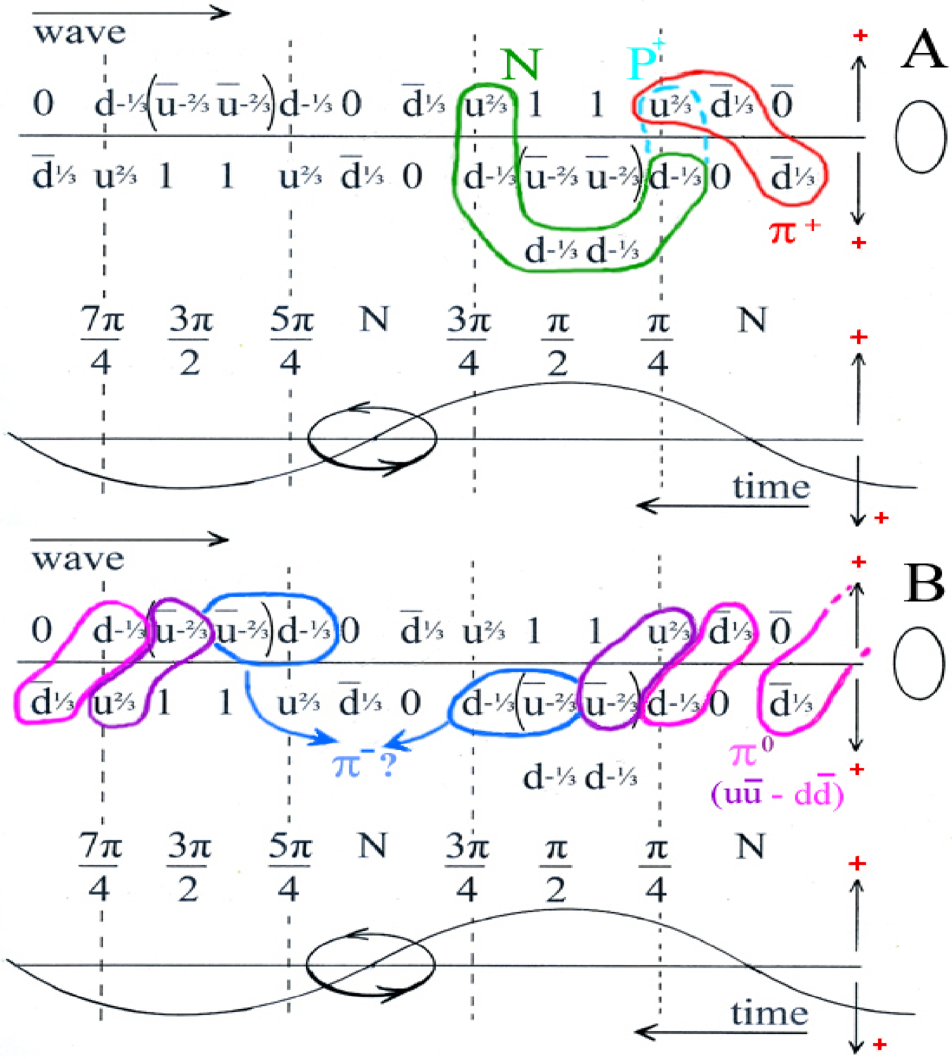

Figure 2: Illustration of quark dynamics around an axis of mean charge of +1/3 (upper horizontal line in each of A and B) hypothetically carried by an electromagnetic wave or the orbiting electron's charge shadow (lower half of the drawings) as described in the text. An observer to the right sequentially sees the indicated quark events starting from the non-local node at 'N' (the nodes are also indicated by circular arrows). In order to see the quark dynamics start with the charge +1/3 to the far right and follow this charge as it simultaneously oscillates to a higher value above and a lower value below the axis of means. The number '0' represents electroneutrality and '+1' a positive elementary charge. The polarization carried by the field uniquely defines the u, d, $\overline{u}$ and $\overline{d}$ quarks. The first particle seen in 'A' at the node of the field is a π^+ pion encircled by red lines, calculated in the resonance example in the text in Chapter 5 to have a mass of 1.8 GeV. Subsequently in 'A' a neutron $d\ d\ u$ is defined by the in green encircled quarks, the d quark is shown to survive the field maximum which would otherwise stabilize a $\overline{u}$-quark. Alternatively (dashed blue lines and green lines) a proton is defined. If one procedes further leftwards the sequence of events is repeated on the other side of the field's mean charge. In 'B' a neutral pion, $u\overline{u} - d\overline{d}$ is first seen around the non-local node (red and magenta). The (leftwards in 'B') subsequently with blue encircled quarks define a π^- which is discarded because of charge incompatibility at the +1/3 mean charge. Instead a proton is defined by the quark sequence $d\ u\ u$ followed by a $\overline{u}$ 'play' quark and this sequence of events is repeated leftwards on the other side of the mean charge. The sequence of events in 'A' is less ambiguous than that in 'B'.

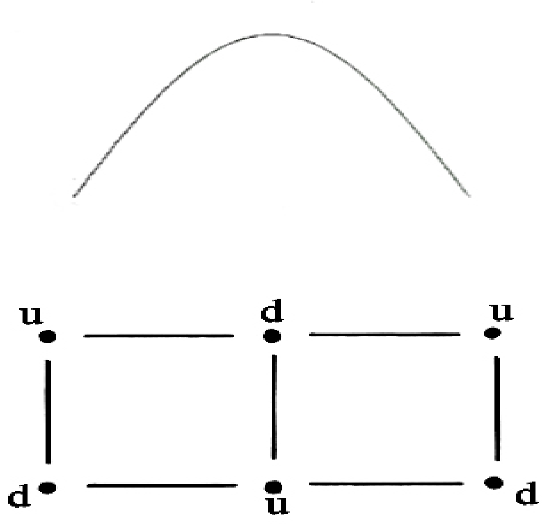

Figure 3: Illustration of quark (dots) dynamics in a hydrogen or helium nucleus. In the upper row of dots, the proton, has the sequence $u\ d\ u$, and in the lower row $d\ u\ d$ represent the neutron popping in and out of existence in the proton or else, a deutron. The lines connecting the dots represent gluons generically, or here, fractions of W-bosons of very short duration. The sinusoidal curve in the upper part of the drawing relates to Fig. 2.

quantitatively that it is possible to relate the masses of the resonance bosons to the local apparent cosmological expansion rate [17] [18]. However, before revisiting and extending these calculations consider a hard ray at or above the transition between Thompson and Compton scattering where one enters the realm of matter-antimatter creation, highly relevant in the context of Fig. 2:

Fig. 2 A and B identifies the u and d quarks (the ones to care most about in stable matter) by their charge only, as they would label the oscillating electric field of such a hard electromagnetic wave. The electromagnetic wave or the electron's charge shadow (lower half of A and B) with its corresponding quark charge label (upper half) is propagating from the left in the drawing towards an observer at the right and the events in the wave proceed on a time axis extending from right to left. Hence a positive charge of $+1/3$ initially associated with a $\overline{d}$ antiquark to the right in the drawing will be subject to charge oscillations above and below the charge equilibrium of $+1/3$ as the wave propagates. The quarks are taken as local and the antiquarks are taken as non-local as discussed previously [18] [29]. The latter interact into the future (leftward in the drawing). This is consistent with the Standard Model's perception of negative energy running on a negative time axis in the sense that an interaction from the future to present time runs backward in time. The local positive energy quarks on the other hand interact into the past (rightward in the drawing) into events just having occurred.

Furthermore, in Fig. 2, the non-local vacuum energy enters the wave at the non-local nodes where the curls attain a maximum. By reference to canceling Stokes' curls such kinetic energy comes from anywhere in the electromagnetic wave and, generally speaking, from anywhere in the universe from other waves than the one illustrated. The local components, the u and d quarks appear at a phase shift of $\pi/4$ from the non-local node at which angle the acceleration of the field is maximal. As discussed in [18], and [12] dealing with electromagnetic radiation this is where the joint non-local and

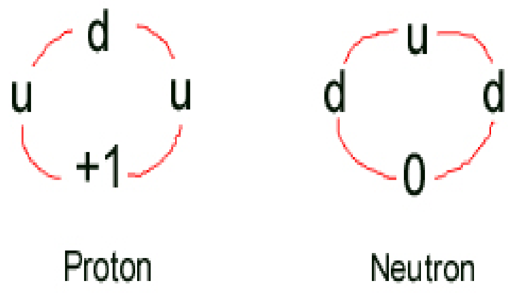

Figure 4: Illustration of quark dynamics in the proton and the neutron. The proton to the left is stabilized by its own charge '+1' (cf. Fig. 2) and the neutron by its being neutral, '0'.

local contribution to the signal absorption is maximal and also where the electron tips its axis to perform a correction of a phase mismatch of relativistic emitter-to-receiver velocities.

Starting from the first node at the right in the drawing a pion, $\pi^+ = u\overline{d}$, is formed (or stabilized by the electric field), its u-quark interacts towards the past with a $\overline{d}$-quark heading towards the future at phase $\pi/4$ where the field defines a u and a d quark. Subsequently ($> \pi/4$) there are two possibilities, either the d survives the antinode at phase $\pi/2$ to sustain a $u \to d \to u$ sequence of events or else, a π^--meson ($d\overline{u}$) is sustained, which is unlikely given the mean charge $+1/3$ of the field. Either way the d reappears at phase $3\pi/4$ and interacts again with the u-quark. The phase interval $\pi/4$- $3\pi/4$ has two interesting features: 1) The u-quark may interact with the charge $+1$ of the proton forming a closed loop $u \to d \to u \to +1 \to u$..... (Fig. 4). 2) This phase interval contains the $\overline{u}$ and d quarks which are known in the specialist literature to be involved in CP-violation in the Standard Model, notably in terms of their couplings to a W-boson in the 3×3 KM-matrix [30]. Hence, the events indicated in Fig. 2 representing stable matter at lower levels of symmetry operations than in the Standard Model decidedly bring in the W-boson as a possible real-time mass-provider as previously calculated based solely on resonance arguments [18]. Furthermore, 3) Along the entire sequence of events in the wave the pion appears as an important player at the quark level as it is known also empirically to do in the atomic nucleus, remembering that it was the first transient particle predicted; by reference to Fig. 3 the presence of the pion even hints at a mass stoichiometry since its mass, 139.6 (π^+) or 134.5 (π^0) MeV, is approximately 1/7 of that of the proton, 938 MeV, such that one pion would be providing mass to one $u - d$ quark interaction (bypassing relativistic gluon dynamics). There may be room for an even better fit since the quarks are theory-sustained and some descriptions presuppose they are mass-less. Another approach to derive the masses based solely on resonance is described in the next Chapter. Furthermore, among the notables in Fig. 2, 4) the u-quarks and $\overline{u}$-antiquarks appear repeatedly on opposite sides of the wave's charge equilibrium at the antinode intervals $\pi/2, ...3\pi/2, ...$ while the $\overline{d}$ antiquarks oscillate spatially at the nodes of the wave. At phase $3\pi/4$ the wave re-sustains its previous u quark-events while the field amplitude of charge oscillates to the other side of its equilibrium value, first interacting with the Stokes non-locality at the node, which in principle may involve a massive field[6], then again displaying a proton or a neutron at the quark level. Finally, 5) a line in space pursued by the wave in Fig. 2 may produce alternately a proton and a neutron over and over again by ignoring the 'play'-quarks, $\overline{u}$ in 2A and $\overline{d}$ in 2B, each time

[6]in the atomic nucleus, or, at the transition where electromagnetic radiation starts to behave as particles

with an electron being elsewhere for charge neutrality while pulling out an average dipole moment of $3\times\ \ +1/3$ on the nuclear surface.

5 Resolving the W Boson Mass by Using the Local Apparent Hubble Expansion Rate

As for how the masses may be generated, recall first the factor $\overline{\Delta q}^2\pi$ in Eq. 3 - 5. Let the cosmological line increment have two perpendicular components that enter squared into a vector current and an axial current postulated to couple to the masses of the W and Z bosons:

$$M_W = AH^2 + B_1\pi H^2 C \tag{12}$$

$$M_Z = AH^2 + B_2\pi H^2 C \tag{13}$$

where $M_W = 80.4\ GeV$, $M_Z = 91.2\ GeV$, $H = \overline{\Delta q} = 0.7714\times10^{-26}m^{-1}$ (Eq. 2) $\rightarrow H^2 = 45\ GeV$ and A, B, C are constants to be identified. Subtracting 13 from 12,

$$\Delta M_{W-Z} = \Delta B\pi H^2 C. \tag{14}$$

The left function variables in the first two equations represent vector currents and the right ones axial currents scaled by the factor π so that the processes of interest take place in the framework of the Z boson. Accordingly, the axial factors to the right are further adjusted by the weak mixing angle θ so that $C = sin^2\theta = 0.229$. Then resonance can be established for some choice of the variables B being integers or quotients of integers, for example $A = 1.71$, $B_1 = 1/9$, $B_2 = 4/9$, and $\Delta B = 1/3$. Applying these values to Eq. 14 yields the result that an energy equivalent of the loss of mass following the $W \rightarrow Z$ transition, 10.8 GeV, resides in the apparent Hubble rate where it is divided by $1/\Delta B = 3$ so that resonance occurs at 3.6 GeV. In Fig. 2, the resonance takes place twice per cycle at the nodes so the number of interest is rather 1.8 GeV. There actually exists a pion having this mass, the $\pi(1800)$ at 1812 MeV which would be able to pump approximately half its mass into the out-of-resonance proton at 0.938 GeV, both particles oscillating in their proper phases shown in Fig. 2. In this context it is also relevant that the quotient 3.6/80.4, its numerator just shown to possibly sustain the matter in the universe, is 0.045, which is the proportion of baryonic matter in the universe in Standard Cosmology (end of edited quote). Actually, the mysterious fraction $\approx 4\%$ appears twice since the mass of a ground state pions, 135-140 MeV is roughly 7.6% of that of the $\pi(1800)$ encountered above. Picking up these fractions of substance in the material world even when using theoretical perspectives so vastly different from Standard Cosmology as here hints at the possibility that there may be some other explanation for SC:s 'dark matter' than its GR framework. The W boson mass calculated above [17] [18] agrees on the third digit (and almost the fourth) with the more recent experimental value [35] obtained by the CDF collaboration (a slightly different value of the mixing angle may have been used there, the one used here is nevertheless within the range of published values considered plausible).

The frame signatures[7] of the dimensions in Eqs. 12 and 13 above are on the left hand side

[7]In this series of papers 'frame signatures' represent the assignments of physical units to the local (a bar) or the non-local (a tilde) frame of observation

$[Energy] = \sim \sim \sim = ^{-} \, ^{-}/ \sim$ and on the right side $[\ velocity^2] = ^{-} \, ^{-}/ \sim \ \sim$ but considering the particles' self oscillation given by [3]

$$\nu_0 = \frac{m_e \ c^2}{h} \ , \tag{15}$$

for example applied to the electron;

$$\frac{9.11 \times 10^{-31} kg \times c^2}{6.6262 \times 10^{-34} kg \ m^2 \ s^{-1}} = 1.236 \times 10^{20} \ Hz \tag{16}$$

$$1.236 \times 10^{20} \ Hz \rightarrow (E = h\nu) = 8.188 \times 10^{-14} \ J = 0.511 MeV \tag{17}$$

or to the proton;

$$2.27 \times 10^{23} \ Hz \rightarrow (E = h\nu) = 1.50 \times 10^{-10} \ J = 938 MeV \tag{18}$$

the 'energies' equivalent of mass on the left sides of Eqs. 12 - 14 represent oscillations (energy per unit time that is) so the dimensions (the frame signatures of the units) are right.

This means that the particles' rest masses should be referenced, not as geometrized lengths but as rates and more precisely by reference to the velocity of light. Starting from the orbiting electron which is entrained to the velocity of light by way of the fine structure constant, its charge shadow on the nuclear surface traced in Fig. 2 is indirectly also entrained to the velocity of light which implies that the particles in their rest frames (like the velocity of light itself) escape any relativistic transformation laws as discussed in [12]. This solves the perplexing puzzle why the particles in this series of papers can be referenced to each other by way of geometrized lengths (meters) since it is not the lengths *per se* that are relevant but the velocity of light, meter per geometrized time unit, which always is 1 length unit per time unit, irrespective of the pitch of the units that form the basis of the geometrization of mass. Hence, in Eqs. 12 - 14 above, the line increment on the unit length (Hubble's local expansion rate) is given per unit time and so are the W and Z boson masses, in retrospect by reference to deBroglie's mass oscillation idea. In a sense, the mass-generating line increment in proper units is served on a plate by the velocity of light. (Another example of this perplexing invariance of mass-energy referenced to the arbitrary SI unit system is that the electron's mass, $6.764 \times 10^{-58} \ m$, is approximately twice that of the local energy density of the CMBR, $3.44 \times 10^{-58} m^{-2}$. This is noteworthy in the present theoretical framework where the cosmological horizon and the orbiting electron are two manifestations of the same non-local observer.)

Then one can proceed and examine the numerical details of Eq. 12 - 14. Here the constant 'A' is rather close to the cotangent of the weak mixing angle: $sin^2\phi = 0.229$ gives $\phi = 28.59$ whereas $cotan \ \phi = 1.71$ gives $\phi = 30.32$, a phase shift (delay) of 1.729^o. The latter is 4.13 times the phase shift, 0.418^o, by which the atomic nucleus sees the orbiting electron in the Bohr ground state by the aberration effect (Eq. 11). Putting $v = 2\alpha$ into Eq. 11 for the helium atom (cf. Ch. 6) instead of $v = \alpha$ gives the angle of delay 0.836, assuming that the factor A is the cotangens. This added to 28.59^o gives 29.43^o, rather close to 30^o, which will be examined below as a possible geometrical context of the mixing angle.

Namely, if 1.71 is the cotangent of the phase delay it is possible to strictly apply the present

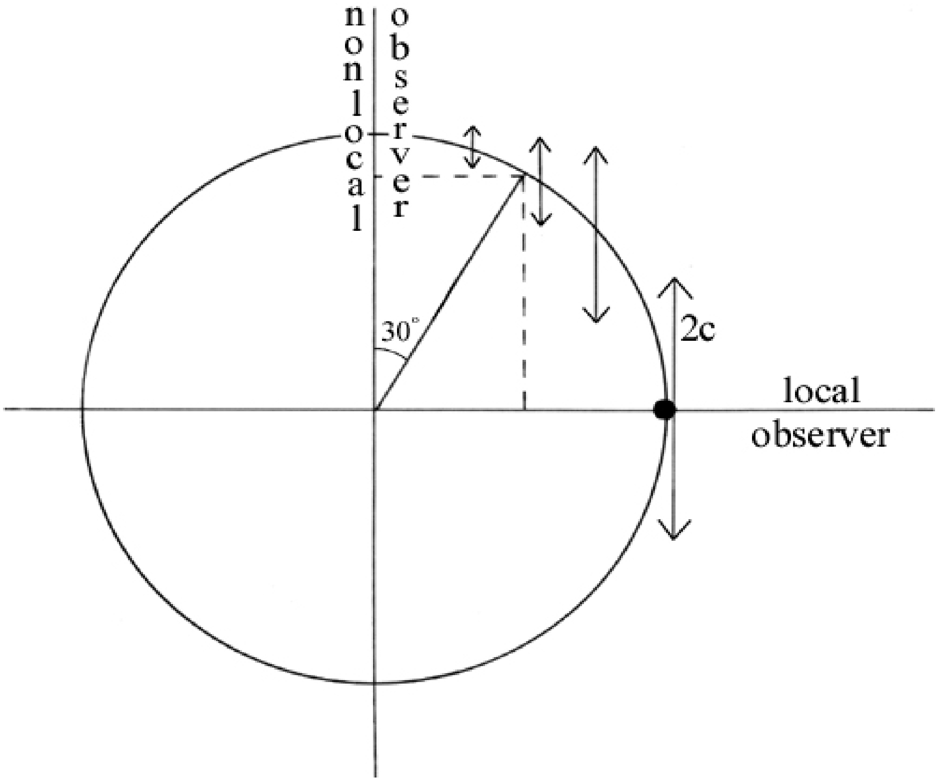

Figure 5: Illustration of the geometry of signal velocity projections from the wavefront, spreading at ($v = 2\pi c$ or) $v = 2c$ in the strictly perpendicular geometry as herein: A physical process takes place at the dot and moves counterclockwise on the unit circle. It is first seen by the non-local observer in its full strength (right-most double arrow), then with decreasing intensity as the process moves counterclockwise (vertical double arrows). At the same time the local observer sees more and more of it and at the angle 30^o measured by the non-local observer the process is transmitted at $v = c$ to the local observer and can be seen.

non-local *versus* local geometry. Suppose an event takes place on the non-local *sinus* axis at time zero. This event could be imagined to be the vanishing Stokes curls of a non-local process suddenly reaching a (Stokes) boundary. The squared form of the line increment per unit time, $\overline{\Delta q}^2$, indicates that the event has taken place, that it has become 'local'. However, in the first term on the right side of Eq. 12 - 13 the event is seen by the local observer on the cosinus axis, per unit contribution from the sinus axis, as a flux emerging and being delayed from the latter non-local axis (a current) by the aberration effect whereas in the second term it is seen instantly like in the case of electromagnetic non-local phenomena such as superpositions. The second term on the right side would then represent some curl or cross product (an axial vector). The plausibility of this architecture applied to the mass emerging from the ubiquitous cosmological line increment is supported by reference to the known case of the orbiting electron which has the same architecture with its known angular momentum - a likely foundation for its being non-local by way of vanishing Stokes curl. Furthermore, the absorption of a light signal by the electron can be modeled as a two-stage process involving first a non-local then a local phenomenon while the electron mechanically adds 'relativistic' time dilatations if necessary in order to compensate phase mismatches between the non-local and the local components of the signal [18] [12]. The geometry just described puts the phenomenon of 'aberration' at the center of the physics of both signal absorption (emission) and mass generation (in both cases orbits are involved) whereas in relativity theory aberration is just a marginalized byproduct of that geometry (e.g. [36]).

Then one can proceed and examine the geometry herein. If light spreads with its linear velocity c and if it is coherent in its wavefront so that various 'superpositions' of the signal can be detected all across the wavefront then the transverse velocity of the wavefront must be $2\pi c$. This can be understood as a 'stretching' and weakening of the signal while it spreads in the two dimensions of a spherical wavefront, which explains the weakening of light's intensity proportional to distance from emitter by r^{-2}. In the present geometry the velocity $2\pi c$ reduces to $2c$ along the non-local axis (axes) as seen by the observer of linear momentum. If one maintains the usual causality argument then the signal can not be seen by the local observer until it is projected at the angle 30^o from the non-local observer, suggesting that the transverse spreading of the signal also involves a rotation. This is illustrated in Fig. 5. Hence, a projection from the nonlocal to the local frame of observation of a light signal (or a similar process like here) is characterized by the angle 30^o, which is very close to the electroweak mixing angle. Then one arrives at the conclusion that a circular process projected on the local axis is accessible from the moment of the nonlocal event and extended with a time delay until it is made invisible by the wavefront's projection velocity reaching $v > c$. The construction in Fig. 5 can actually be regarded as a special case of the one used in [37] where it was shown by using thermodynamic arguments that inertial mass is equivalent of electromagnetic radiation. Similarly to the present theory the mass in [37] is contributed by oscillations but the oscillations there are in terms of pressure, not embedded in the geometry like in the present theory (herein, the pressure is non-local, $[kg/m^2] = \frown / --$, furthermore, the line increment is equal to a tangential velocity, $v = \overline{\Delta q}/s$ [13]). Hence, [37] antedates not only the mass-'energy' equivalence of relativity theory but also the cosmological black body radiation (being related to mass generation in the prevailing Big Bang cosmologies) and possibly, as theorized above, the mass generation in the Standard Model, even in terms of 'quarks' (Fig. 2).

Although the present theoretical-geometrical framework so far seems to be right the numerical fits are rather rough but they fall within the right magnitude and within a digit or two. This is more of a philosophical problem however: Shall one request that matter be like precise grains of sand in a sandbox (scattering etc.) or shall one admit the raison d'être of mismatches standing aspiring in line (interference, crystal imperfections, etc.)?

This or that, there is a better way, which goes by scrapping the Standard Model of elementary particles altogether. Start by disintegrating the magnetic pole in its context of Eq. 5, in other words, transferring its scaling factors to the line increment:

$$\overline{\Delta q}\ \frac{ce}{2\alpha} \quad \rightarrow \quad \left[\overline{\Delta q}\frac{c}{2}\right]\ \frac{e}{\alpha} \tag{19}$$

where $\overline{\Delta q}$ is given in geometrized units while c still is an invariant scaling factor for the magnetic pole, numerically given by the SI-system of units. Subsequently, calculate the mean life time of the W boson from its width [30]

$$\tau_W = \frac{\hbar}{\Gamma} \ \rightarrow \frac{1.055 \times 10^{-34}}{2.085\ GeV} = 1.1142 \times 10^{-18}\ s = 3.712 \times 10^{-27}\ sec. \tag{20}$$

Since the strength of a resonance is equal to the time it lasts, one gets the result from Eq. 19 above that $0.7714 \times 10^{-26}\ m^{-1} \times 3 \times 10^8\ /2 = 1.156 \times 10^{-18}\ s$ which is rather close to the meanlife of the W boson of Eq. 20. The remainder can be transferred to the factors on the right side in Eq. 5, giving:

$$\frac{\alpha}{e}\ \pi\ Ampere\ \ \rightarrow \frac{\pi\ v_e}{137} \quad (21)$$

where v_e is interpreted as the electron's orbit velocity (Chapter 3, Eq. 5). As of the Bohr ground state of radius r_B, its encircling electron -matter wave(length), λ_{dB}, the electron's orbit frequency, ν_e and its orbit period τ_e:

$$\lambda_{dB} = 2\pi r_B;\ \ v_e = \alpha c \rightarrow \nu_e = \frac{v_e}{\lambda_{dB}} = 6.52 \times 10^{15}\ Hz \rightarrow \tau_e = 1.5210^{-16}\ sec = 5.07 \times 10^{-25}\ s \quad (22)$$

applied to Eq. 21: $\pi \times 1.521 \times 10^{-16}/(137 \times 3 \times 10^8) = 3.70 \times 10^{-27}\ s$ (borrowing back the c scaling factor (the magnetic charge's invariance) from the left side of Eq. 5 thus keeping the originally intended interpretation of the equation) which is rather close to the geometrized meanlife of the W boson, $3.72 \times 10^{-27}\ s$. This means that the orbiting electron, the W boson and the apparent cosmological expansion rate are all in resonance[8], justifying the numerical approach used in Eq. 12 - 14 and corroborating the theory of Chapter 3. Since the fine structure constant is known for its 'running' towards higher values there is a possibility here of achieving a much better numerical fit on the basis of this resonance compared to bringing in the Standard Model. Possibly, the fine structure constant could for stoichiometric reasons be the inverse of an integer, indeed, after all, in which case 137 would turn out to be a very exceptional prime number. Anyway these calculations based on the theory in Chapter 3 (and 4) nicely bring together quantitative measurements in the fields of 19:th century spectroscopy, modern astrophysics and high energy particle research.

6 Where is the Atomic Nuclear Mass Actually?

Now, return to the problem in Chapter 2 of the shape and spatial boundary of the proton and the nucleus. After having dragged this through the sub-elementary particle level as in Chapter 3-5 it seems there can be no doubt that the shape of an atom is just like in the textbooks - a point-like nucleus surrounded by an electron cloud...... - Point-like as seen by the observer in the laboratory, that is. How does the orbiting electron perceive the nucleus? This is a rather important question considering that the problem is not just how the atom is observed by the experimentalist in the laboratory, rather every observer and every measuring apparatus being used in the experiment all make use of orbiting electrons as well. The answer is rather simple, in principle: Since the electron orbits around the nucleus the nucleus orbits around the electron too, at the same velocity - and it is inappropriate to introduce a third observer *via* the 'reduced mass' since there are only two observers here, confined to a closed system.

In Chapter 4 the assumption was made that the nucleus does not have any preferred orientation along which to observe the electron. Hypothetically it could rotate with the electron and perceive it as a stationary point but if that were the case the nucleus would have its positive charge at one pole which would lead to consequences that have not been observed experimentally. Therefore, it likely perceives the electron as a rotating wave. This rotation on average cancels in all directions so the nucleus has a privileged rest frame - a rest frame which happens to be the same as the one where the experimentalist conveniently observes it. The electron, however, sees the nucleus in orbit at the

[8] in other words; they are different manifestations of the same physical process

distance of its corresponding shell, which is a sphere in the ground state cases and its perception of the nucleus is further blurred by its own angular momentum, the latter being consistent with itself rotating mechanically [32]. Since its angular momentum is coupled to the atomic mass its spin is likely coupled to existing (or emerging) nuclear spins so it likely has a preferred orientation along which to observe the nucleus and this orientation likely follows the nucleus' orbit (as seen from the electron's perspective). This poses the question: Does the electron's undulatory imprint on the nuclear surface, hypothesized in Chapter 5 to be involved in mass generation, vanish, as seen by the electron? Yes or no, in either case does the nucleus cease to exist as a local particle even though the electron senses its mass. In terms of charge, the same arguments as in the case above of the nucleus being the observer apply, so the electron, not being a dipole either, rather, in the shape of a spherical charge, sees the nucleus as a wave - a matter wave. If it were a dipole rotating with the nucleus it would emit radiation and it doesn't. Hence it's charge behaves as an isotropic sphere towards the nucleus. - The electron's angular momentum and its charge behave differently towards the nucleus as would be consistent with the electron actually being two distinct particles [33] [24] [34] performing different roles in signal absorption [12] [18]. The electron's perspective in the atom, seeing the nucleus to that extent spatially spread out, effectively casts in doubt the measurements of the nuclear radii that have been made in the laboratory and the same would apply even if the nucleus were perceived as a point since the point on average would occupy a larger volume. The question is then: Who will correctly perceive the nucleus, the experimentator alerted to return (with non-relativistic speed) from a coffee break or the persistently hard-working rotating electron? No doubt about the answer - and it is numerical:

The rotating electron's imprint on the nuclear surface evaluated in Chapter 4 relies on the tangential velocity of the electron relative to the nucleus but the imprint *per se* is perpendicular along the radial extension. Nothing prevents the electron from perceiving these dipole fluctuations in its frame of observation which is stationary relative to its orbiting nucleus. The electron need not register its charge imprint on the nucleus at the moment it takes place, it could, for example, register the rebound of the nuclear dipole while it and the nucleus move transversely relative to each other. In summary therefore, as deduced by plain logic, the electron has three separate tools at hand, its angular momentum-rotation, its charge distribution - spherical on average, and the dipole pitch of its imprint on the nucleus. As a result, it emerges much more complex than if it were just a point (or a 'wave') in space shuttling between various 'energy' levels which is the prevailing idea. Furthermore, the electron and its atomic nucleus cemented into a pair, one being local and the other non-local, arbitrarily, offers a rather profane explanation of the so called 'wave particle duality'. The known radius of a free electron is longer than that of the nucleus while its radius when in orbit is not known, the radii of its constituents in orbit may be flexible and roughly the same as the nuclear radius.

Now, the purpose of the following is to evaluate how the electron might perceive a matter-wave emerging from the orbiting atomic nucleus. Recall the century-old Bohr theory[9] [38] [31]:

$$v_r = \sqrt{\frac{Zk_e e^2}{m_e r_n}}, \quad (v \propto e\sqrt{Z}), \quad r_n = \frac{n^2\hbar^2}{Zk_e e^2 m_e}; \quad (r_n \propto e^{-2}Z^{-1}) \tag{23}$$

and calculate the relevant parameters for hydrogen and helium (He-4) chosen for a) being primordial in cosmology and b) having a stable nucleus sometimes forming an endonuclear particle. (Table II), their nuclei (Table III), and the charge-projection of the orbiting electron on these nuclei (Table IV).

[9] Z = atomic number, e = electron's charge, k_e = Coulomb constant, r = radius of orbit, n = quantum number, 1,2,3...,m_e = mass of the electron, $\hbar$ = Planck's reduced constant, $\hbar = h/2\pi$

Table II Reference Data for the Hydrogen and Helium-4 Atom							
A	Z	3 Charge	4 Radius	5 Circumference	6 Velocity	7 Frequency	8 Period
1	1	$1+1$	5.292×10^{-11}	3.325×10^{-10}	2.188×10^{6}	6.580×10^{15}	1.520×10^{-16}
4	2	$2+2$	1.323×10^{-11}	8.312×10^{-11}	4.376×10^{6}	5.263×10^{16}	1.900×10^{-17}

Table II. Tabulation of reference values for the proton and the Helium-4 atom: Mass number (A), atomic number - nuclear charge (Z), 3. Charge, 4. radius of the 1s electron orbit, 5. 1s electron's orbit circumference and 6. 1s electron's orbit velocity, 7. The electron's orbit frequency and 8, its orbit period.

Table III Nuclear Mass Self Oscillations			
A	2. ν	3. λ	4. $\lambda/2\pi$
1	2.269×10^{23}	1.321×10^{-15}	2.103×10^{-16}
$2+2$	9.016×10^{23}	3.325×10^{-16}	5.292×10^{-17}

Table III. deBroglie mass self oscillations according to Eq. 15 of the proton and the Helium-4 nucleus. The latter's mass is calculated as $4.003Da$. Tabulated are the frequency (2), wavelength (3) and a reference radius of the wavelength assuming the latter is wrapped around in orbit (4).

Table IV Charge Projection on the Nuclear Surface by the Orbiting Electron					
A	2. Radius (r)	3. $2\pi r$	4. Velocity	5. λ (deBr)	6. ν (c)
1	1.439×10^{-15}	9.04×10^{-15}	$59.5\ m/sec$	6.658×10^{-9}	0.450×10^{17}
2	1.813×10^{-15}	11.4×10^{-15}	$75.0\ m/sec$	2.6×10^{-9}	1.14×10^{17}
$2+2$	2.284×10^{-15}	14.4×10^{-15}	$755\ m/sec$	1.320×10^{-10}	2.272×10^{18}

Table IV. Calculation of the projection velocity of the electron onto the nuclear surface, the velocity of its 'charge shadow' for the hydrogen and the helium atom. The numerical values in column 2 and 3 were obtained using the relation $r = r_1 \times A^{1/3}$ where r_1 is the proton radius obtained from Eq. 1. The velocity of the charge shadow (column 4) was calculated by multiplying the value in column 6 of Table II with that in column 2 above and dividing by the value in column 4 in Table II. Subsequently, the deBroglie wavelengths in column 5 were calculated based on Eq. 9 neglecting the relativistic term and a corresponding frequency (column 6) was obtained using $\nu\lambda = c$.

By comparing columns 5 in Table II and Table IV it can be concluded that if the electron perceives the nucleus as a matter wave that matterwave would envelope a sphere slightly bigger than the atom's ground state seen by the experimentalist in the laboratory. This applies both to the hydrogen atom and the helium atom but in the latter case the fit is tighter. In He-4 the nuclear matterwave seen by the rotating electron might be stabilized by the closeness of the electron cloud, which should contribute to helium being prone to superfluidity [12]. Besides offering the nuclear matter a convenient escape from its point-like confinement and offering it an external handle for generating matterwaves the inverted perspectives of the electron and the nucleus might be responsible for saltatory motion of the entire atom. In principle therefore, atom particles may not necessarily be like grains of sand in a sandbox even though they appear to be. One of the inner electrons of the 1s shell will be present to sustain these mechanism and the hypothesized quark oscillations in all elements starting from helium (or hydrogen), an argument extendable in the case of ions to 'electron holes' in empty space.

7 Hiding Away the Concept of 'Energy' into the Archives

Consider now the ambiguous 'Energy', our relic of the phlogiston substance - the alchemists' vogue of the Medieval Ages - the Medusa monster of modern physics and contemplate Eqs. 7 - 8 -one of the many contexts where it appears:

$$U = \frac{\delta\sigma}{\delta k}$$

It is now asserted that this equation holds the key to a correct understanding of the concept of 'energy' and not the many 'energy levels' vaguely defined in terms of a Δ that are seen everywhere else. In the present geometry the 'energy' acquires a frame signature[10] of the form

$$[Energy] = \frac{\bar{}\ \bar{}}{\sim} \tag{24}$$

as a consequence of the linear momentum being local and time and mass being non-local. This form indicates a composite process and not at all a proper physical unit as in the textbooks and by encoding a process it provides clues to what kind of process takes place. It may encode a phase shift as in Eq. 8 (Fig. 6A), a change of velocity (Fig. 6B) or a process involving transfer between the local and non-local frames (Fig. 6C) as has been shown to be the case in thermal radiation [19]. It has long been known that following emission or absorption of electromagnetic radiation the electron settles with different velocities in new orbits like in Fig. 6B and more recently it has been shown that the absorption (emission) process *per se* can be carried out by a Lorentz transformation [18] [29], cf. [13] and the latter are known [39] [40] to be decomposable into a rotation ($\bar{}/\sim$) and a boost ($\bar{}$). Since Lorentz transformations encode relativistic effects (that is; the emitter's velocity relative to the absorber) this leads to the notion that the absorption (emission) process, relativistic or not, is just a manifestation of any of the cases illustrated schematically in Fig. 6 - the obscure notion of 'energy' unveiled (save the potential energy which relies on gravity or Coulomb attraction) while in an instant rewinding all of relativity theory back into the phenomenon of aberration. This idea can be tested by observing that, if the absorption is a two stage process requiring the correction of a phase mismatch [12] [18] [1] then the tilting angle (rotation!) of the electron relative to the incoming wave allows for time dilatation of receding as well as approaching emitters.

Based on the results in Chapter 5 it is now possible to extend these ideas to material objects. Namely, the line increment[11], argued in Chapter 5 to encode material mass, can be regarded as a mere

[10] Herein a symbol $\bar{}$ is used for units assigned to the local linear momentum frame and a symbol $\sim$ for those units that are assinged to the non-local frame of observation.

[11] eqv. Hubble's apparent (local) cosmological expansion

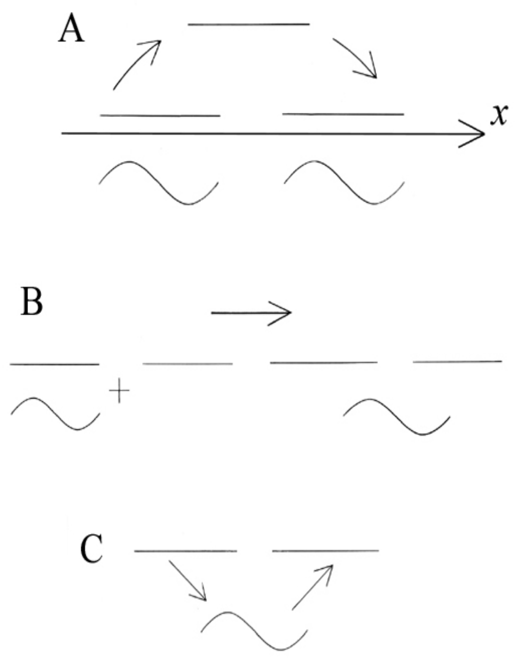

Figure 6: Schematic illustration of the notion of 'energy' in the local - non-local world of the present theory. The composite nature of the energy is indicated by bars (local) or tildes (non-local), $[Energy] = \bar{\ }\ \bar{\ }/\sim$, whereby A above indicates a phase shift (a line increment on the x-axis transferring a composite process to another position), B indicates a velocity boost along the local x-axis and C indicates a process shuttling between local and non-local frames of observation.

phase mismatch between the local and non-local frames of observation - a forever lasting piece of evidence of the universe's lack of determination whether to exist (local frame) or not to exist (non-local frame). This idea was evaluated numerically above by factorizing the Planck length and referencing the thus obtained line increment to the heavy resonance particles. Here too, a phase shift appears to be involved so there is good reason to believe that the 'energy' of both electromagnetic radiation and matter actually are similar processes[12], not so remarkable after all, considering the reciprocal roles of the atomic nucleus and the electron discussed in Chapter 6. Furthermore, the electrons perspective of the nucleus may be used as a blueprint for better understanding the geometry of the universe [1]

Against this perspective of having cast in doubt some foundations of physics that have their roots in the Medieval Ages (phlogiston) and having found an alternative workable concrete path to build the material world it is possible to reevaluate the 'state of the art' of the 'physics' of 'mass': Quote ([41] As of July 15, 2022): "It is worth noting that the Higgs field does not 'create' mass out of nothing. In Higgs-based theories, the property of 'mass' is a manifestation of potential energy transferred to fundamental particles when they interact ('couple') with the Higgs field, which had contained that mass in the form of energy."...."...the mass arises because the potential energy has the profile of a Mexican sombrero hat..." In as much as gluon dynamics contributes to the mass of particles this idea too relies on the vaguely defined concept of 'energy' since in these theories it is hypothesized that the relativistic 'kinetic energy' of the gluons contributes the bulk of the mass by way of the 'natural' geometry of RT.

[12]a venerable tradition, starting with electrostatics-gravitation

The question is: Has modern physics indeed explained what mass is?....especially considering the ambiguous concept of energy just scrutinized above. And this is only going to get worse as one touches 'gravity' and general relativity theory since the former's bending of light can be understood in terms of refractive index slowing down the phase velocities (cf. Fig. 6B) [42] and the latter is founded on gathering all forms of 'energy' under one 'hat' without specifying exactly what kind of processes takes place. This should be possible by using methods like in Fig. 6 to visualize and intuitively understand the physical processes and their relativistic distortions without having to believe in a 'natural geometry' handed down by the prophets.

8 Looking at the Early 20:th Century Physics in Perspective

In the following brief history of early 20:th century physics the focus is on what might have happened in the years 1920-25 when the redshift of remote galaxies was discovered. At that time it had been learned that the electron has an angular momentum and this should have appeared to the scientists of the time as one possible explanation of the redshift although the precise mechanism was not (is) known. By that time, about 10 years earlier, relativity theory had become established as one possible theoretical framework for explaining many phenomena in physics. This theory was in the process of being imprinted in the minds of the general public with the help of the mass media. Some scientists were betting their careers, reputation and influence on relativity theory. They were now confronted with the fact that a mere rearrangement of the terms in the Lorentz transformation highlights that a rotation is inherent in relativity theory. Would they re-evaluate their earlier results, the world was watching, and moreover, cast doubt over the idea that had become prevalent that simple electronic energy levels are responsible for absorption-emission of radiation? Everyone knows the answer and its consequences: A 'natural' geometry that endows the signal with the capability of predicting ahead of time the relative motion of the emitter and the absorber and an infinite universe, 'created' in a single point of space. The only good thing about these conclusions is that they are contrary to common sense so one can be certain that the fundamental flaws will be pinpointed sooner or later.

However, the inertia in society stemming from the mass media having hijacked the prevailing theories at an early stage is prohibiting. Try to say that there is no such thing like 'energy' or that relativity theory is wrong and you run a certain risk of being considered for an asylum. It would be like saying in the ~~21:th~~ 17:th century that the ~~Sun~~ Earth revolves around the ~~Earth~~ Sun. So, in conclusion; phlogiston in disguise, Medusa monsters, an academic liturgy around a divine geometry and people in society risking the dungeon for finding out the truth - has anything changed since Medieval Ages?

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