Characteristics Of a One-Dimensional Universe Spanned Between a Local and a Non-Local Observer. *

Erik A. Cerwen*

**www.scienceandresearchdevelopmentinstitute.com*

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Abstract

Special and general relativity theories are critically evaluated regarding their contemporary role as a foundation for a cosmological world picture. It is argued that the rest frame, where all physical processes take place, is more important in this role than the various relativistic distortions of these processes seen by different remote observers. This idea was previously formulated quantitatively with numerical examples from the Bohr atom, quantum physics and astrophysical observations. The theory identifies an observer on one local spatial dimension *via* Lorentz transformations connected with a space-like separated perpendicular observer who is non-local and only measures time. It was shown that this geometrical construction, where each unit local length comes with a line increment, is relevant both to the atom and to the universe. For example, the Planck length obtained from the Bohr atom could be expressed in terms of the apparent local Hubble expansion rate and the latter substituted into the Schrödinger equation to yield a circular current surrounding a magnetic pole. The distant non-local observer sees the radius Lorentz-contracted at relativistic speeds ultimately so much as to be able to contribute dynamics to the local frame, which was exemplified numerically by the CMBR. Evidence was also presented indicating that the oscillating line increment is capable of contributing mass from vacuum *via* the resonance particles. Elaborating on the latter idea indicates energy contributions of around $80, 90$ and 125 GeV embedded in a robustly defined geometrical framework that has relevance (and even precedence) also in classical physics. The apparent transition from one to several spatial dimensions is exemplified by reinterpreting Compton scattering. The emergence of additional spatial dimensions and tangible locality are also discussed in terms of the number π which appears by applying the Wallis product to the 1-D universe. The presence of the number π thus indicates the presence of local particles as further exemplified by the CMBR and Compton scattering. The mass of the 1-D universe is obtained by considering local as well as non-local contributions as prescribed on the basis of the geometry. This yields corrections to the 'classical' geometrised mass such that the universe's baryon particle density visible on the local axis is close to its electron density. Several unrelated numerical approaches guided by the proposed geometry indicate that the particle density of a primordial universe is roughly $1\ m^{-3}$ ($1\ m^{-2}$).

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1 Choosing Between Special Relativity and Simplified Reality

In relativity physics there is one observer who performs the measurement in his rest frame and another one who, from his distinct rest frame, emits the signal that is being measured. As a result of the measurement, the signal is lost for any third party, which is an axiom in quantum measurement theory. Nevertheless, Relativity Theory (RT) presupposes a third observer, namely the one who knows that there are relativistic alternatives to the actual observation as is described by the various transformation laws that constitute RT. This third observer who provides the velocity spectrum given by the Lorentz transformations, is inert in the theory and deprived of the option to observe, thus constituting a serious violation of the quantum physical rule that any observer is part of the system being observed. The several difficulties in 'unifying' RT and Quantum Physics over the years are probably related to this fact. Even the most successful attempt, the Dirac equation, is supposed to lack some experimental evidence, [1]. The argument that RT and Quantum Physics are made compatible in the Dirac equation can be turned around to claim the equation proves that they are not compatible unless corrections of spin and spinors are added.

Furthermore, there is no evidence that any particular relativistically correct observation is entangled to the other observations that were not made at that particular moment even though they could be expressed by the velocity spectrum of the Lorentz transformations. The absence of evidence of entanglement to all possible velocities applies to SR and even more to GR, (mass and curvature entanglement not mentioned). As seen from the particulate quantum observer's point of view (e.g. an atom), once an appropriate amount of energy has been transferred to it, it has no way of computing all the void interactions, firstly because of all the information processing needed, secondly because several of the void interactions make no sense to it. Namely, a particle has some internal structure in its rest frame, which allows it to absorb a suitable amount of energy from the exterior. As this happens the various impossible energy transfers computed by an observer who is not part of the system are irrelevant, whether based on RT or any other theory. Or, more generally speaking, any observer only makes observations in his rest frame. This is, in most cases, where the actual physics arises (although, of course, the actual physics may be seen from the distorted perspective of another rest frame). Thus having discarded anything but the rest frame when it comes to selecting velocities one is also forced to accept that all observations are made at present time in the observer's rest frame and hence, that the coordinate of present time has a privileged role in quantum physics (and indeed for any intelligent observation). One is then faced with the task of finding a geometrical framework that highlights these facts while still being compatible with Special Relativity Theory (SR) and General Relativity Theory (GR).

The wave front of light provides a clue to further simplifying the geometry of observation in order to accomplish this task. The manner of propagation of light and its absorption into matter do not indicate that space-time or that even space by itself is isotropic from the point of view of the material observer. On the contrary, the wave front is composed of perpendicular magnetic and electric vectors that are non-local with respect to their transfer of momentum to material particles and only when momentum has been transferred is the third spatial dimension made local and visible to the absorbing particle. This process suggests the existence of at least two non-local dimensions and one local dimension, the latter actually being seen by the quantum observer. When soft radiation is absorbed into the fitting quantum states of matter the rule is that all or none is absorbed. There is no composite energy level resulting from contributions from three different directions. One quantum unit of radiation is absorbed with some probability that depends on the intensity of the radiation and its inclination off the maximum possible absorption normal to the wave front. This suggests that, in the case of soft radiation, the local axis is at right angles to the wave front. The local axis may be interpreted as the momentum axis for linear as well as angular (axial) momentum.

In summary, the geometrical environment of some of the most fundamental physical processes can justifiably be simplified considerably by disregarding relativistic alternatives, opting for present time (a recurring brief interval of time encompassing the events observed) and restricting oneself to one spatial dimension knowing that there are additionally at least two dimensions that appear non-local to the quantum observer. Whether this geometry of space-time exists on its own or if it requires some physical content in order to exist is an open question at this point. However, the simplification along the arguments above goes beyond the latter philosophical problem since, for example, one must opt for the Coulomb gauge to describe electromagnetism and leave the Lorentz gauge for mere relativistic distortions. The Coulomb (or transverse) gauge allows a photon to transfer energy instantly to a local particle from its arbitrarily large wave front. In modern theoretical physics an arbitrary dimensionality has become common practice so why not start with the simplest such system, one single spatial dimension as described above, instead of the three classical ones that the early 20:th century physicists took for granted. The above distinction of an absolute rest frame of observation where the actual physics takes place is very different from the notion of an observer in SR or GR where an observer often is synonymous with a four velocity of some sort in four dimensions, mostly an intelligent observer viewing the physics from a distance. Even though SR has many successful quantitative applications it can be debated whether many of these merely are a variety of mathematical descriptions, some even pure mathematical abstractions, or if they really promote a better understanding of the actual physical processes taking place in the rest frame.

2 Summary of Previous Results

A geometrical construct having the properties described in Section I above was discovered in 2001 [2]. This geometry is defined by performing Lorentz transformations between four space-time coordinates that define an interval of time (a unit of time) in the one-dimensional frame of observation, which is also the momentum frame. This 'local' observer can define length changes as well as time intervals. A space-like separated frame of observation, which appears to be transverse to the momentum frame, is defined as a result of these operations. The observer in the transverse frame only observes time and is taken to be non-local based on several criteria [3]. The mathematical details are as follows: A length q is defined proportional to the inverse of the x_1 component of the four-velocity and Lorentz-transformed from discrete time $t = 0$ and $t = s\sqrt{1 - v^2/c^2}$ to a barred frame of observation, which yields $\overline{q} = v^{-1}m^2/s$ at $t = -1$, where m = unit of length, s = *geometrised* unit of time (non-standard notation), c = velocity of light) and a line increment in the local one-dimensional frame, $\overline{\Delta q} = -vs$, which is associated with the lapse of time from $\overline{t} = -1s$ to $\overline{t} = 0s$:

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

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

$$\overline{\Delta t} = \overline{t_r} - \overline{t_0} = 1\ , \quad \overline{\Delta q} = -vs; \tag{3}$$

$$\Delta t = t_r - t_0 = s\sqrt{1 - \frac{v^2}{c^2}}\ , \quad \Delta q = 0 \tag{4}$$

The barred observer appears to be located on the periphery of a circle [1] but is space-like separated from the observer at the origin (origo), meaning that the latter's location can not be determined by the former. As required in Section I, the barred observer sees the plain radius undistorted by relativistic transformations (eq. 1, right side) and is able to measure local ('proper' in SR) time. Furthermore, he sees an infinitesimal radial line increment on each unit length, the inverse of which increment defines the linearly perceived radius,

$$\overline{q_0}\ \overline{\Delta q} = -m^2 \tag{5}$$

In contrast, the non-local observer computes the radius to be Lorentz-contracted and is only able to measure relativistic time. Non-local time and mass appear perpendicular to the local frame of observation and transform as seen by the local observer like in SR. Accordingly, the local observer infers a slow-down of events at his radial horizon (the origin, that is) and an increase of mass there. In contrast to SR the momentum carried by the line increment is linear (non-relativistic) as would be expected at the particle level where the processing of information about relativistic alternatives at the moment of momentum transfer is redundant. As was also discussed in Section I, the axial vector- or linear momentum is transferred along the one-dimensional axis, distinct from classical or semi-classical 3-D phenomena like Compton scattering since it implies probabilistic all-or-none quantum transfer along the axis instead of additive contributions from three 'headwind' dimensions. While preserving some elements of SR, this construction takes care of two forgotten or overlooked problems in that theory, namely 1) the ambiguity regarding transverse and longitudinal mass (cf. [4]) and 2) that the Lorentz-Fitzgerald contraction actually can not be observed [5] [6]. Namely, 1) longitudinal mass can be seen by the momentum observer but only in his rest frame and 2) Lorentz-Fitzgerald contractions only take place in the space-like separated (not to be seen) non-local frame. In the present theory, time dilatations (or time contractions) are perceived as the main causes of relativistic effects, not length contractions like in classical textbook SR.

The line increment (cf. eq. 5) pertaining to some radius that quantifies the geometry numerically can be added in a linear fashion (cf. eq. 3, left side) to each unit length until $\Sigma\overline{\Delta q}/s = 1m/s$, which defines a relativistic horizon. This results in a 'Pythagorean' construction with deeper and deeper line increments farther from the observer, proportional to an increasing tangential velocity (similarly to rotating spiral galaxies, cf. Eq. 3, right side) that can not be seen by this same observer. An oscillating line increment thus stretching to the relativistic horizon implies by Stoke's or Gauss's theorems the possibility of a physically active boundary at that horizon. Even though the local observer concludes that the boundary is far away the non-local observer by eq. 1 and 2, left sides, computes the radius to be immensely Lorentz-contracted at relativistic speeds, ultimately so much as to be able to contribute any dynamics to the local frame of observation.

In eqs. 1 and 2 the spatial coordinate always remains a function of velocity so that neither frame is a rest frame relative to that velocity, which is different from standard relativity theory where coordinates in a moving frame are transformed to a rest frame with zero velocity or *vice versa*. It is well known that standard relativity theory provides no absolute coordinates and the Lorentz transformations merely serve to describe the experimental or theoretical set-up as seen by any observer. In contrast, the Lorentz transformation defines here the two observers' absolute location as described in detail above, aiming at providing a geometrical framework for physical processes taking place in the rest frame. Instead of a continuous time-axis which guarantees the invariance of the interval in SR the present geometry only defines a non-relativistic time interval around zero in the momentum frame, $-s \to 0$, left side of eq. 3, in order to account for the fact that all observations are made at present

[1] Some similar ideas also including rotations have been published in the field of GR; cf. Grøn and Jemterud, Eur. Phys. J. Plus (2016) 131: 91 and references therein

time (an interval of time during which the signal transfer takes place, that is).

The present geometry allows non-locality to be defined and investigated quantitatively in that two of our known spatial dimensions are hidden from the momentum observer. These naturally harbor perpendicular non-local phenomena known to physics, like electric and magnetic vectors of radiation and time-dependent wave-functions. Accordingly, the square of the radius, the non-local area perpendicular to the local observer, that is, acquires a particular status in the present theory. Also in classical physics is the square of the radius related to non-locality, as in the case of the waning intensity of an electromagnetic wave-front or gravitational interaction between two increasingly separated masses. Thus, the non-locality is defined here as just $Y = r^2$ where r is the distance from the particle (or mass). Other definitions of non-locality can be found in other areas of physics. As for the term 'locality', tangible locality is intended here, such as to allow the momentum observer to absorb a local quantum of energy. An example of tangible locality extending from a particle known from the literature is the Yukawa potential. The formulation of locality in the present context is still open although an extension of as much as half or the entire radius of the particle is thinkable. Such a distance might accommodate, for example, induced dipoles. Elsewhere in the physics literature, locality is occasionally taken to be synonymous with 'time-like separated', which is too large to be suitable for the present purposes. As will be discussed in Section III the very concept of locality in physics remains an unidentified problem to this day, which can be approached and formulated in terms of a non-relativistic interpretation of the Lorentz factor.

The line increment that comes with each unit length in this geometry suggests that one should be looking for a physical implementation primarily in terms of the Bohr atom and/or the apparent cosmological expansion [2]. This was pursued for several years resulting in some quantitative results: Starting from the Bohr atom in the ground state using common standard notations [7] [8],

$$a_0 = \frac{4\pi\epsilon_0}{e^2}\,\frac{\hbar^2}{M_e} \Leftrightarrow (a_0\alpha M_e)\Big(\frac{e^2}{4\pi\epsilon_0\alpha}\Big) = \hbar^2 \tag{6}$$

the radius, a_0 and its geometrised inverse $\alpha M_e/\hbar$ are factorized out (These represent an instance of respectively the local and the non-local frame in the present geometry) leaving

$$\frac{e^2}{4\pi\epsilon_0\alpha} = \hbar \tag{7}$$

The Planck length squared can then be identified as (cf. e.g [8])

$$\hbar = \frac{(2g_0)^2}{(\pi\overline{q}Ampere)^2\ m^4} \tag{8}$$

where g_0 is the magnetic charge, $ec/2\alpha$, and $\overline{\Delta q} = -m^2/\overline{q}$ is the line increment ($\overline{q}$ will be used for $\overline{q_0}$ in the following), equal to $\overline{\Delta q} = 7.71410^{-27}m^{-1}$ provided the magnetic charge is an invariant proportional to the electric charge by including the factor $c = 2.998 \times 10^8$ (This instance of c shall not be geometrised). This line increment corresponds to H = 71.36 km/second/Mparsec, a reasonable choice for the local Hubble expansion rate (cf. [9] [10], most recent measurement gives 73.24 +/- 1.74). Later in this section the same number will be identified in the density of local CMBR and in the elementary resonance particles. The Planck length can then be interpreted as a kernel for electric or magnetic interaction whereby the luminal charge velocity ec (at the horizon) has been taken down to the unit length by dividing by the through π curled radius (this might be interpreted as a 'compactified' dimension in the numerator). The manner of arriving at eq. 8 shows that rearranging terms such as to identify longitudinal and transverse frames in accordance with the proposed geometry is a workable method for solving problems. Following up on this idea, the commonest physical entities like, mass, time, charge, velocity, etc. have been assigned 'frame signatures' reflecting whether they appear in the momentum frame or the non-local frame [11] [8] [12]. Hence, rearranging the linear Schrödinger equation (SE) for a free particle (cf. [3] [13]),

$$\frac{p^2}{2M_e}\ \Psi = -i\hbar\frac{\partial}{\partial t}\ \Psi \Rightarrow \frac{\hbar^2\nabla^2}{2M_e}\ \Psi = -i\hbar\frac{\partial}{\partial t}\Psi \tag{9}$$

into

$$\frac{\hbar}{2}\ \Big(\frac{\partial}{\partial x}\Big)^2\ \Psi = -iM_e\frac{\partial}{\partial t}\ \Psi \tag{10}$$

presents the local frame on the left side and the non-local, transverse frame on the right side (both mass and time are perpendicular to the local observer, both are contained in the de Broglie-Schroedinger 'wave' that envelopes the atomic nucleus). Further substituting $\hbar$ from eq. 8 into eq. 10 and rearranging yields

$$\overline{\Delta q}^2\ \Big(\frac{ec}{2\alpha}\Big)^2\ \Big(\frac{\partial}{\partial x}\Big)^2\ \Psi = i\ M_e\ \frac{\partial}{\partial t}\ \Psi\ (2\pi\ Ampere)^2 s^{-2} \tag{11}$$

which makes physical sense: The left side (the 'local' observer) contains angular momentum (first term) times magnetic charge squared (the second term), the latter originally identified as a one-dimensional string [14] . The perpendicular circular current squared is in the non-local complex plane on the right side of the equation. This form eliminates Planck's constant in favor of a plausible physical mechanism namely, circular currents giving rise to magnetic poles that are contracted by the factor $\overline{\Delta q}$. Like the substitution of the Planck length in eq. 8 this form is also indicative of a kernel [2] for magnetic and electric interaction.

In order to transit from the quantum world to the classical world, assume that a finite amount of geometrised local mass in the universe, $\overline{q}$, exists at the present interval of time and also existed one interval of time earlier and so forth until the relativistic horizon is reached at $\overline{q}^2/\overline{q} = \overline{q}$. Using the above value of the line increment such a universe is 13.7 billion years old as seen by the local observer. The relativistic boundary of unit length of such a universe oscillates at a rate equal to c as seen (without relativistic distortions) by the local observer. On the other hand, the radius perceived at relativistic speeds by the non-local observer is Lorentz contracted of (eqs. 1 and 2, left sides, where $\overline{q} \propto v^{-1}$: the non-local observer also measures local time to be contracted at relativistic speeds, eq. 4, left side). Per unit diameter of primordial matter, $2a_0$ (or rather the effective arc of the Bohr shell, $2\pi\alpha a_0$, of the hydrogen atoms), interacting with radiation, the energy of the oscillation, $E = h\nu$, would be

$$E = \frac{1}{2}\ h[1]\ \frac{1}{(2\pi\alpha a_0)} = 3.38210^{-58} = 0.256\ eV/cm^3 \tag{12}$$

where [1] is the frequency of oscillation at the relativistic horizon in the units chosen and α is the fine structure constant, while a published experimental value of the density of the CMBR in the current epoch is 0.260 eV/cm^3 [15]. Other, hotter, values of the CMBR that can be measured at intermediate distances require an analysis of those particular space-time coordinates also taking into account relativistic distortions resulting from the signal travelling here. These radial coordinates are not defined by eqs. 1 and 2, which only identify the radius (= the x-coordinate), the line increment, and the velocity.

Another potential application of the oscillating line increment can be linked to the discovery in 1904 that the energy of a suddenly expanding-contracting radiating cavity is equivalent of oscillating mass,

[2]the word 'kernel' is used here in the semantic sense of a brief mathematical expression that directs physical processes that can be linked to it, a kind of functional element of the real world. There are many more or less precise definitions of 'kernel', especially in physics

$E = (3/8)mc^2$ [16].[3] This energy-mass equivalence does not depend on relativistic effects (although the Lorentz-Fitzgerald contraction was referred to in the paper), which makes it suitable for the local observer in the present theory. The mass can be solved in several ways. For example, using elements of the Standard Model [17] exploring the possibility that the masses, M, of the resonance particles (the B and Z bosons) can be expressed in terms of the local line increment, $\Delta q^2 = 45\ GeV$,

$$\Delta M_{W-Z} = \Delta B\ \pi\ \overline{\Delta q}^2\ C, \tag{13}$$

a good numerical fit was obtained [18] with $\Delta B = 1/3$ and $C = sin^2\varphi = 0.229$ where φ is the electroweak mixing angle [17] [18]. The above is based on regarding the electroweak interaction as a contribution from vector and axial currents, $M_W = A\ \overline{\Delta q}^2 + B_1\ \pi\ \overline{\Delta q}^2\ C$ and $M_Z = A\ \overline{\Delta q}^2 + B_2\ \pi\ \overline{\Delta q}^2\ C$. Here, C is an empirical constant which evolves as more progress is made in its determination, a current numerical value is 0.23116 [19] (the value 0.229 seems to fit rather well too, cf. Fig. 3 in the reference). The constant B, is chosen arbitrarily to have an integer in the denominator, as this might facilitate resonance with the line increment. The square of the line increment appears in the equations in order to express the non-locality of the vacuum energy (for example multiplying from two perpendicular dimensions into the momentum frame at right angles). This interpretation is similar to the square of the amplitude in textbook quantum physics. The square may also be regarded as angular momentum as originally argued [18]. The equations aim at expressing that the mass is sustained by the dynamics of the resonance particles (not necessarily created earlier) and that the mass derives its energy from the vacuum energy of the line increment. The line increment squared may also be regarded as a Lorentz contraction into the local momentum frame of the perpendicular squared time interval very close to the universe's relativistic boundary.

3 Towards a 3-Dimensional Classical World

In GR, the archetype of force, gravitation, is removed from its physical context (for example the solar system) and ascribed entirely to the geometry of space-time. Here, gravitational force is turned into a measure of the extent of departure from a space-time that is not curved using a vector perpendicular to the four-velocity of the not curved space-time [20]. Similarly to the case of the displacement current in electromagnetism a mathematical trick was used to make the geometry divergent-free [21]. Whereas the physics of the displacement current has been discussed a lot in the scientific literature ever since its introduction by Maxwell its counterpart in GR has been ascribed to geometry *per se* and an explanatory physical mechanism is not required in principle since the geometry is regarded *a priori* as once forever fixed and detached from physical processes. However, *via* various 'solutions' of its geometry might physical mechanisms be evaluated. GR has been tested mainly in local gravitational contexts whereas its applicability to other forms of energy and the universe as a whole remains largely hypothetical and still linked to a lot of wishful thinking not in the least with respect to 'dark' matter, 'dark' energy, and standard Big Bang Cosmology. The contemporary funneling of so many observations into one and the same latter theory is rather unprecedented in science, for example from the perspective of the various theories of thermal radiation, which are less ambitious than a theory of the universe but nevertheless much richer and more diverse (reviewed in [22]). Especially is this so when one considers that the free parameters in GR, often have not been proven to be anything else than theoretical constructs.

Nevertheless, the gravitational constant that yields the force between two local masses forms the basis of many sound applications of GR. In the present theory it is contained in the geometrisation of mass, which is necessary for deriving the local line increment from the Bohr atom as described above.

[3] This paper is interesting in that it in addition to the formula itself, contains surprisingly many arguments that were later interpreted to be consequences of relativity theory

The value of Hubble's constant thus obtained actually agrees better with the most recent observations than does Big Bang cosmology [10].

Whereas SR usually is concerned with to and fro velocities along one spatial axis, GR is robustly multi-dimensional. The question then arises how to arrive at the three classical dimensions starting from the one-dimensional world described in Section II. The simplest answer is perhaps that the classical world is just a collection of particles defining their momentum axes in a random fashion. Otherwise for example, Compton scattering is the most primitive event that allows a particle to define more than one spatial dimension. Compton scattering was originally derived using the radiation's relativistic momentum and interpreted as evidence that light is a stream of particles, 'photons'. Rewriting (using the Bohr atom) Compton scattering,

$$\lambda' - \lambda = \frac{h}{M_e c}(1 - cos\varphi) \tag{14}$$

as

$$\frac{2\pi\alpha a_0}{c}\Big(1 - cos\varphi\Big) = \tau' - \tau \tag{15}$$

where the left side represents the local dimension and the right side the transverse one, is interpreted here in the following way: In order for the emitted radiation to come out along the electron's elementary interaction radius, αa_0 (or rather the corresponding arc, $2\pi\alpha a_0$), the incoming radiation must be projected on that radius from an angle perpendicular to its wave-front (represented by the period τ, outgoing radiation is primed, incoming is not primed) such that its transferred energy fills out the elementary interaction radius in the emitted direction. This way of writing the Compton scattering lends support to the 1+0 -dimensional world picture promoted in this text. There is no momentum transfer to be seen in eq. 15, the radiation just proceeds in another direction along another momentum axis because of the difference in the radiation's period. The energy transfer is not necessarily point-like but rather continuous along the interaction radius, as would be expected of a (local or non-local) oscillating process. On the other hand, the classical derivation of Compton scattering was influenced by the classical expectations at that time that transfer of momentum must involve a local particle (the 'photon'). Hence, different theoretical frameworks lead to different interpretations of the physics, just like in the rich case of thermal radiation theory (reviewed in [22]).[4]

Three spatial dimensions can be inferred from eq. 15 while there is no evidence in eq. 14 of the presence of any local particle, which really is a mandatory prerequisite for any kind of classical momentum transfer between particles. What is it actually that makes a particle tangibly local? This is an overlooked problem in physics it turns out, and very much related to the transition to an additional spatial dimension through the number π.

The number π which forces a straight line into an arc over a local point is of interest when a multi-dimensional system in abstract Hilbert space collapses into a unitary probability distribution measurable locally in three classical dimensions. The various technical approaches so far available offer no explanation *why* classical behavior is tangibly local as opposed to the entangled superposition states. A tentative answer is provided by applying the Wallis product,

$$\prod_{n=1}^{\infty} \frac{2n}{2n-1} \cdot \frac{2n}{2n+1} = \frac{2}{1} \cdot \frac{2}{3} \cdot \frac{4}{3} \cdot \frac{4}{5} \cdot \frac{6}{5} \cdot \frac{6}{7} \cdot \frac{8}{7} \cdots = \prod \frac{4n^2}{4n^2-1} = \frac{\pi}{2} = \prod \frac{1}{1-1/4n^2} \tag{16}$$

[4] thermal radiation can also be rearranged to conform with the present local *versus* nonlocal geometry [22], [13] [23]. Hence, the Schrödinger equation, the Planck distribution and Compton scattering constitute examples in which rearranging terms results in an interpretation of the physics in conformity with the present geometry

to the one-dimensional universe described in Section II. The numbers of the Wallis product are interpreted as (infinitesimal or finite) units of length in the present geometry $x = 2n$, each length being defined in terms of the closest shorter length on the scale, added linearly until the relativistic horizon is reached at $\overline{\Delta q} = 1$. Using the square is consistent with the arguments discussed in connection with eq. 13 and also in connection with eq. 18 below. The non-local observer at the horizon sees the radius immensely Lorentz-contracted towards the local observer at close to luminal velocities, which can be interpreted as a kind of locality complementary to tangible locality proper, but only after the local observer proper has accounted for "the rest of the universe" using the above indicated iterative procedure applied to his linear universe.[5] Also Gauss's and Stoke's theorems applied to any oscillatory process lead to that, ultimately, only the luminal "frame" at the relativistic horizon needs to be accounted for such that superluminal velocities can be discarded and a boundary is defined. As a result of the above-described processes, a particle identified as being local through the presence of π appears from two non-local dimensions. This method of arriving at a classical 3-D world should be evaluated against the background that some theories relating the 2-D remote to the 3-D local already exist, like group contractions [24] [25] and "the holographic universe" [26]. As for the role of π proposed here, it is already known through practice that the reduced Compton wavelength, $\lambda/2\pi$ is used with mass (particles) as opposed to the non-reduced Compton wavelength, λ, which is used with energy [27]. The present results may be interpreted in terms of the squared radius (cf. Wallis) being related to diagonal elements "collapsing" into the classical world from the two perpendicular dimensions not seen by our proposed one-dimensional observer (cf. non-local wave functions like the electron orbit), leading to an intuitive and robust geometrical framework for such quantum phenomena instead of the present purely mathematical one. The Lorentz factor squared is equal to the Wallis factor with $\overline{q}/m = 2n$, and $v = 0.5n^{-1}m/s$ (right side of eq. 16) which justifies the latter's interpretation in terms of the geometry described in Section II. It is interesting that the plain Lorentz factor can provide the number π.

In GR, objects are made gravitating (local) through rotations by employing a predefined classical 3-D spatial geometry that is isotropic, leaving unsolved the problems 1) how the three known spatial dimensions arise and 2) why objects that are not subject to a force may nevertheless be local. The mechanisms of the emergence of tangible locality is an overlooked problem in GR just like in quantum physics and Compton momentum scattering.

The local mass-energy on the unit circle, for example expressed as geometrised mass,

$$\int_0^1 x = 1 \quad , \tag{17}$$

increases linearly from $x = 0$ to $x = 1$. On the other hand, the non-local mass seen by the local observer by transferring the Lorentz factor of the left part of eq. 4 to the left side, by the rule $(d/dx)\ arcsin\ x = 1/\sqrt{1-x^2}$ yields

$$\left[2\sqrt{1-x^2} + x^2\right]_0^1 \quad , \tag{18}$$

where the x-axis represents the local observer, starts at the function value 2, follows a rather modest declining slope in the beginning and then declines more rapidly until the function value 1 is reached at $x = 1$ which is the same as in eq. 17. Here, the first factor may be identified as the diameter on the unit circle, which is non-local from the perspective of our local observer who resides on the x-axis. The local observer will be under the impression of a 'Big Bang' of declining energy density as the radius

[5] The problem of the finiteness or infinity of the universe is related to the existence or non-existence of some last digits of the number π. Here, the universe has an active and finite relativistic horizon, so π may have to be truncated at some point. The choice of length unit is also of importance, of course

grows from 0 to 1 even in the absence of any GR whatsoever[6]. However this interpretation requires that the radius *does* grow, which is not necessarily the case, and in particular not so in the present oscillating universe. An anisotropic mass distribution like in eq. 18 is consistent with the existence of many anisotropic objects identified by astronomical observations, a fact largely neglected in GR. An observer evenly surrounded by a disc of mass, rotating or not, might interpret the latter to not have any mass at all and to be gravitationally non-local. Such an observer might nevertheless be able to observe mass along an axis perpendicular to the disc ('jet'-direction of some astronomical objects). The apperance of the anisotropic cosmic web where possibly the galaxies are aligned predominantly along their axes seems somewhat estranged to the isotropic theory of GR.

Recalling eq. 13 and retrieving the masses,

$$M_n = B_n\ \pi\ \overline{\Delta q}^2\ sin^2\varphi + A_n\ \overline{\Delta q}^2 \tag{19}$$

with $n = 1$ for the W-boson and $n = 2$ for the Z-boson, the constant A can be solved from the condition $M_W = M_Z\ \cos\varphi$; $A = 1.647 = 1.068 \times 2\times\ \cos^2\varphi$ improving the analogy with eq. 18 (save the factor 1.068) leaving the constants $B_1 + B_2 = 5\pi/9 = 1.745$. In spite of the mass difference (eq. 13) giving a perfect fit this procedure causes the absolute masses to become smaller ($M_W = 80.4 \rightarrow [77.1]\ GeV$ and $M_Z = 91.2 \rightarrow [88.5]\ GeV$) by 4.1% and 3.0% respectively. Moving all mass to the B-factors and subtracting 0.745 of it yields 127.8 [123.4] GeV (this latter calculation is guided by having the sum of the $B_n\pi$ -factors of three equations equal to one, save the angle contribution, which improves the analogy with eq. 18). On the other hand, let the first factors including B represent the non-local axis of eq. 18, then their mass contribution for the resonance bosons combined are $1.745 \times 0.229 \times 171.6\ [165.6]\ GeV = 68.6\ [66.2]$. This equals 253.4 [244.4] GeV spread over both the first and the second factors of the resonance bosons combined, the angle included; $2 \times 1.647 + 0.3997$. Shrinking the angle to 0 ($\Rightarrow x \rightarrow 1$ in eq. 18) and distributing this mass equally over the non-local and local axes would yield 126.7 [122.2] GeV to remain accessible to the local observer. These numerical exercises indicate the possibility that three distinct 'particles' are involved in the mass-energy resonance of the Hasenöhrl oscillation at the cosmological horizon and that one of those contributes roughly 125 GeV. The Standard Model surely predicts three mass resonance bosons (the W, the Z, and the Higgs boson, the latter with unknown mass, experimentally now thought to be 125.1 GeV). In the absence of an explanation of the electro-weak mixing angle in the Standard Model also the present calculations must await the integration into a more comprehensive theory, perhaps with fewer free variables and including a transition from fragments of mathematics into a comprehensive world picture. The numerical deliberations above suggest that nature has provided a robust geometrical platform for such calculations.

The particle density of this universe can be estimated in several ways.[7] For example, eq. 13 suggests one particle per unit length since one of each of the resonance bosons would be required to sustain a baryon. The energy density of the CMBR ($3.382 \times 10^{-58}\ m^{-2}$ eq. 12) is obtained by dividing with the electron's elementary interaction radius (the arc, that is), which also indicates one particle per unit length. The numerical value of the energy density of the CMBR is half of the electron's geometrised mass (6.764×10^{-58}), again indicating one half, or better, one particle per unit length. A roughly matching number of protons (0.53) can be obtained from the one-dimensional universe's energy density (the local energy density, that is, extended linearly to the horizon, cf. eq. 17) by using a proportion of baryons borrowed from Big Bang Cosmology [28]. The undivided energy density however corresponds to 11.43 protons per cubic meter, which is too high (see below). From eq. 5 and

[6]An interesting result similar to eq. 18 has been reported in GR though; R.C. Tolman (1934), quoted in Misner and Putnam, Phys. Rev. 116(4) 1045

[7]By particle density is intended the likely density of electrons or un-fused baryons (like protons and neutrons) before nucleosynthesis

$$|-m^2| = \bar{q}\ \overline{\Delta q} = \frac{M_e}{\sqrt{\hbar}}\ \frac{2a_0\alpha}{\sqrt{\hbar}} = 1\ . \tag{20}$$

By analogy,

$$\frac{M_p}{\sqrt{\hbar}}\ \frac{2r_p}{\sqrt{\hbar}} = 12.4 \tag{21}$$

where M_p is the proton's mass and r_p its radius, which sharpens the mystery of the universe's missing mass-energy, the correction 12.4 being so close to 11.43 above. Knowing that the electron as described by eq. 20 is non-locally distributed at the tip of the Bohr radius, eq. 21 may be interpreted in terms of the proton having a corresponding non-local mass, distributed on its own circumference. This mass would be 12.4 times the proton's actual mass. Now, one would like to solve the missing mass problem on the basis of the ideas presented in this paper. As argued in this paragraph a solution amounts to having a local baryon density of roughly 1 particle per m^{-3} by finding corrections to the density 11.43 m^{-3} above. In order to find some corrections one has to opt for a universe that redefines itself by the dynamics of its oscillations at the particle level (eqs. 13 and 19) and by particle creation from vacuum (eq. 16 rather than a universe that evolves. The universe's visible evolution on the local axis is sustained by dynamics on the non-local axis of eq. 18. This implies that instead of evolving from the left factors in eq. 18 towards the right factor causing a 'Big Bang' both exist at the same time at the full extension of the radius as formulated in the beginning of Section II and, by arguments of energy conservation, precisely unchanged. Hence, the local frame, where the particles are, contributes only 1/3 of the total geometrised mass. Furthermore, only the energy that actually resides in a local point-shaped particle is borrowed from that available in the vacuum, so the latter is contracted by the factor $4\pi/3$ per unit radius. These corrections yield a particle density of $11.43/(4\pi) = 0.91$, which better matches that of the electron above. Some other calculations are also compatible with a baryon density of 0.5 or 1 m^{-3}, for example the finding [28] that the radius of the atomic nucleus per half-life of neutron decay $1.3 \times 10^{-15}/882 = 1.47 \times 10^{-18}$ is close to a linear extension of the line increment, $\overline{\Delta q}\ sec^{-1} = 2.313 \times 10^{-18}$. Half an electron and half a proton would then be created per unit length and unit time on the radius of the universe (half its diameter) as a consequence of some resonance with the apparent expansion rate yet to be characterized. Also the decay of the Λ_0 particle per square meter of the cosmological horizon is interesting in this connection [8]. Each hemisphere of the universe generates per geometrised second one set of decay products on each square meter;

$$\frac{E_{\Lambda_0}}{c\tau}\ 2\pi(\bar{q})^2 = 1.98 \tag{22}$$

($E_\Lambda = 1.48 \times 10^{-54} m;\ \tau = 2.631 \times 10^{-10} sec,\ c = 3 \times 10^8$). The Λ_0 particle decays into primordial baryons and might be regarded as an excited state of the primordial universe.

References

[1] Wikipedia (2016) Article on the 'Dirac Equation', paragraph dealing with the zwitterbewegung. www.wikipedia.org

[2] E. Cerven (2001) On the physical contexts of Lorentz transformations around zero time. In Proceedings of the Seventh International Wigner Symposium, Baltimore. Ed: M. E. Noz, 2001 http://ysfine.com

[3] E. Cerven (2014) Non-Locality, Copernicus' Principle, the Density of CMBR, and a Quantitative Relation Between the Hubble Rate, the Planck Length and Ground State Dynamics. (Version 2) Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 19, (also published under another title). The author's own items in this reference list are all unedited unless indicated on the web-site.

[4] A. S. Eddington (1924) The Mathematical Theory of Relativity. 2:nd Edition Chelsea Publishing Co. N. Y.

[5] J. Terrell. (1959) Invisibility of the Lorentz contraction. Phys. Rev. 116(4) 1041-1045

[6] R. Penrose (1958) The apparent shape of a relativistically moving sphere. Proc. Cambridge Phil. Soc. 55(1) 137-139

[7] E. Cerven (2004) Factorization of the Planck length in terms of a line increment of the order of Hubble's constant and magnetic charge. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 3,

[8] E. Cerven (2010) Quantitative analysis of atom and particle data yields the cosmological expansion rate in the form of a vacuum instability. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 13,

[9] P. A. R. Ade *et. al.* Planck 2013 results. XVI Cosmological Parameters. www.arxiv.org , astro-ph/1303.5076v3 average of 8 determinations of H_0 in Fig. 16

[10] A. G. Riess *et. al.* (2016) A 2.4% determination of the local value of the Hubble constant. www.arxiv.org 1604.01424

[11] E. Cerven (2006) Exploring the physicality of physical units in a one-dimensional universe. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 8,

[12] Table of Dimensionality of Physical Units. (Link provided under ref. 8 above on that URL)

[13] E. Cerven (2016) From atom to universe in a 1+0 -dimensional world. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 20,

[14] P. A. M. Dirac (1948) The theory of magnetic poles. Phys. Rev. 74(7) 817-830

[15] Astrophysical Constants, the edition of the year 2000 http://pdg.lbl.gov

[16] F. Hasenöhrl. (1904) Zur Theorie der Strahlung in bewegten Körpern. Ann. d. Phys. 15 344- available through http://de.wikisource.org

[17] Available at http://pdg.lbl.gov

[18] E. Cerven (2004) Evidence of resonance between the W-boson and the apparent cosmological expansion rate. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 4,

[19] Jefferson Lab https://www.jlab.org/qweak/

[20] R. Geroch (2013) General Relativity. 1972 Lecture Notes. Minkowski Institute Press Montreal, Quebec http://minkowskiinstitute.org/mip/ ISBN 978-0-9879871-7-4

[21] mathpages.com (2010-11-07): Maxwell's Displacement and Einstein's Trace http://www.mathpages.com/home/kmath103/kmath103.htm

[22] E. Cerven (2005) The first arbitrary event. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 5,

[23] E. Cerven (2008) Rethinking thermal radiation by using its mathematical form in gene kinetics, cognitive psychology, and economics. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 10,

[24] E. Inönü and E. P. Wigner (1953) On the contraction of groups and their representations. Proc. Natl. Acad. Sci. U.S.A.

[25] Y. S. Kim and E. P. Wigner (1990) Space-time geometry of relativistic particles. J. Math. Phys. 31, 55

[26] Wikipedia (2016) Article on the 'Holographic Principle'. www.wikipedia.org

[27] Wikipedia (2016) Article on the 'Compton Wavelength'. www.wikipedia.org

[28] E. Cerven (2010) Geometry and particle number of the Bohr-Dirac universe. Proc. of www.scienceandresearchdevelopmentinstitute.com , Quantum Physics and Cosmology No. 15

4 ADDENDUM

Aug. 23, 2016

1. The proton radius was obtained by extrapolating neutron scattering cross section radii as a function of nuclear mass number, $R = 1.37\ A^{1/3} \times 10^{-15}\ m$ (cf. Fernbach *et. al.* Phys Rev. 75, 1352 (1949)), omitting the last digit. More recent data emphasize charge interaction measurements which have been shown to be context-dependent (cf. wikipedia.org (proton) and Science Mag. 353(6300) pp. 669-673 (2016).

2. The rest frame discussed in Section I may be taken in its widest sense, if one wishes, as the rest frame *containing matter in its ground state.*