

# The physics of nothingness

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The paper claims that physical laws are amenable to consideration in terms of an algebraic pattern arising solely from the omega constant that underlies both a spatial limit of the universe, implying its scale invariance, and the fine structure constant that stands for changeability of the universe in time. Given that connection, we are able to deduce all fundamental physical quantities exclusively from the omega constant, which makes it possible to meet certain fundamental challenges faced by physics.

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## 1. Introductory remarks

At the outset, it should be pointed out that the research to be presented addresses physical issues in terms of dimensionless physically meaningful quantities conceptualized, first and foremost, in accordance with the concept of the first cause. In principle, both causality and the idea of an originary numeric nature to the world order are not antithetical to scientific reasoning though the suggestion, of course, is foreign to physics that is basically dimensional and causeless. However, it is precisely number that implies the most fundamental level of reality, thus providing the most general analysis of any system, irrespective of its particular elements and the nature of their interconnections; and it is precisely the first cause that allows the principles of causality, least time and least action to be pieced together, thus making it possible not only to connect causality with physics, but also to explain how exactly conservation laws came into being.

## 2. Quest for fulcrum

Today, the universal tendency in exploring the origin of time-space is for physicists to seek for appropriate clues not so much in the initial state of the universe as in the structure of the physical laws governing the universe of today. The reason for this is plain: there is no physical footing for appropriate concepts in the very early universe, to say nothing about a pre-time universe, which is the ultimate epistemic limit beyond which traditional physics insights no longer work. However, it was the physicist Migdal [1, p. 184] who gave us a strong clue about a way in which that challenge might be met; he assumed that an ultimate frame of reference for the universe as a whole might somehow be connected with the following relation:  $\alpha \cdot \ln \xi \sim 1$ , where  $\alpha$  is the fine structure constant  $\frac{e^2}{\hbar c}$ , while  $\xi = \frac{\hbar c}{G \cdot m^2}$  is a typical “large number” which, judging from the order of magnitude, is relevant to the macro-scale of the universe (the departure point here is that the five fundamental physical constants (Newton’s constant  $G$ , light speed  $c$ , Planck’s constant  $\hbar$ , the electron mass  $m$ , and the electron charge  $e$ ) can yield only two physically meaningful independent dimensionless quantities:  $\alpha$  and  $\xi$ ). Given that  $\alpha \cdot \ln \xi = 1$  is true if  $\xi = e^{\alpha^{-1}}$ , we have certain grounds to assume that a logically consistent ultimate connection between the micro- and macro-scales of the universe may be described in terms of the following  $\alpha$  –based entirely completed recursion:

$$(\alpha) \cdot (e^{\alpha^{-1}}) \cdot (\alpha \cdot e^{\alpha^{-1}}) \approx 10 \cdot \omega \cdot 10^{114} \quad (1)$$

The left-hand terms of Eq. 1 can be interpreted as dimensionless quantities that stand for three pillars of mechanical motion: contraction-extension ( $\alpha$ ), rotation ( $e^{\alpha^{-1}}$ ) and translation ( $\alpha \cdot e^{\alpha^{-1}}$ ); of particular relevance is that the product of these terms equals roughly  $\omega \cdot 10^{115}$ , where  $\omega = W(1) \approx 0.567 \dots$  is the omega constant,  $W$  is the Lambert function defined as the function that solves the equation  $z = W(z) \cdot e^{W(z)}$ , where  $z$  is a complex number (throughout this paper,  $z$  indicates a complex variable,  $x$  a real one). Physically,  $\alpha$  is a variable that mediates between the electro-magnetic and nuclear forces, but Eq. 1 tells us that  $\alpha$  can be thought of as a mediator between the macro- and micro-scales of the universe, which, theoretically, makes it possible to deduce the value of the alpha corresponding to the ultimate equilibrium of the universe from the following strict equality:

$$(x) \cdot (e^{x^{-1}}) \cdot (x \cdot e^{x^{-1}}) = 10 \cdot \omega \cdot 10^{114} \quad (2)$$

Solving this equation reveals that it has three real roots, all of them depending purely on the omega constant:

$$\mp x_{1,2} = \mp R_w = -W^{-1}(\pm R_w^{-1}) \text{ and } x_3 = \alpha_w = -W_{-1}^{-1}(-R_w^{-1}) \quad (3)$$

where  $R_w = \alpha_w \cdot e^{\alpha_w^{-1}} = |\sqrt{10 \cdot \omega}| \cdot 10^{57}$ , and  $W_{-1}$  is the bottom branch of the Lambert function defined for  $x \in [-e^{-1}, 0]$ . Expectedly,  $x_3 = \alpha_w \approx 7.29739 \dots \cdot 10^{-3}$  is remarkably close to the currently accepted value of the fine structure constant  $\alpha_c \approx 7.29735 \dots \cdot 10^{-3}$  (in what follows, low index “c” means “current”, which is interpreted as the running value of a physical quantity in question). Here we should remark that  $\alpha_c$  refers to micro-dynamics, while  $\alpha_w$  refers to its real fulcrum that is manifest in the ultimate equilibrium between the micro- and macro-scales of the universe, as described by Eq. 2 (in what follows, equations 2 and 3 are thought of as describing the genuine equilibrium of the universe). Given such conceptual link between real physical dynamics and its idealized equilibrium, it is logical to assume that the value of the fine structure constant ought to vary as quanta pass from their ground states to the scale of the electro-magnetic force; in the micro-realm the limit of this force is manifest in the speed of light, while, its macro-equivalent should manifest itself in an upper limit of translational motion of the universal quantum vortex; encoded in the “large number”  $R_w = \alpha_w \cdot e^{\alpha_w^{-1}}$ , that limit can be interpreted as the radius of the universe corresponding to its real fulcrum, its genuine equilibrium. Of particular interest is that such equilibrium implies that the universe is in the state of complete coincidence with itself, which can be reached via a series of identity transformations, meaning approaching self-similarity (which is exactly what the *modus operandi* of the Lambert function implies, and this becomes perfectly obvious if the function is represented as a series of continued logarithms). Mathematically, self-similarity of a unique specimen can be written formally as follows:  $R_w^{-1} \cdot R_w = 1$  (here it is appropriate to talk about the culminating term of the recursion in question,  $R_w$ ). Since  $R_w$  is thought of as representing the upper limiting radius of the universe, its inverse value  $R_w^{-1}$  can be thought of as representing the smallest spatial measure of the universe, equivalently, the shortest wavelength contributing to the zero-point energy associated with a spatial limit of the universe; in what follows, this quantity will be referred to as the radius of the void particle:  $0_w = |R_w^{-1}| = |r_0| = (|\sqrt{10W(1)}|)^{-1} \cdot 10^{-57}$ .

Next, it would be reasonable to shed some light on the “large number”  $G_w = e^{\alpha_w^{-1}}$  that mediates between  $\alpha_w$  and  $R_w$ . Given that rotation is prior to translation, we are able to claim that the electro-magnetic and nuclear forces derive their entire dynamics from the *causal* information encoded in  $G_w$ , implying a measure of rotation of the universal quantum vortex linked to the genuine equilibrium of the universe (note that the range of the rotation exceeds that of the translation (by  $\frac{G_w}{R_w} = \alpha_w^{-1}$ ), which is a mathematical manifestation of a physically indoctrinated claim that it is rotation that causes translational motion, but not the other way round). To make the causal link between rotation and translation both physically and ontologically relevant, we ought to establish an epistemic connection between undifferentiated void (associated with entropy, chaos and disorder) and its ontic opposite—a finely quantified and completely disentangled quantum vortex. Encoded in  $G_w$ , such vortex implies ideal cosmic order arising from perfect rotation, and it is physics that allows  $G_w$  to be interpreted in a manner that may be considered both logically relevant and consistent with physics: given that gravity is considered to be the first force that split off from the other three fundamental [translational] forces in the early universe, we are able to claim that the exact opposite of entropy is gravity (which, according to our convention, is manifest in pure rotation of the universal quantum vortex).

Now, we approach the fourth term of Eq. 2,  $10\omega \cdot 10^{114} = \Omega = R_w^2$ . Inversed, it can be thought of as the inverse square of the “world radius” ( $\Omega^{-1} = R_w^{-2}$ ), which is physically relevant to the concept of the cosmological constant, implying certain initial state of the universe. Given that insight, we are able to connect the initial and boundary states of the universe as follows:  $\ln\Omega^{-1} = -\ln\Omega$ ; logically, this equation encapsulates a concept of becoming of the universe; quantified in terms of the omega-based  $r_0$ , successive extensions and contractions of void particles set up a one-to-one mathematical correspondence between  $r_0$  and the appropriate limits of the universal quantum vortex encoded in the alpha-based  $R_w$  and  $G_w$ , which is ontologically relevant to transforming of undifferentiated void into spatial-and-temporal order. Here it would be appropriate to note that the insight proposed gives us a perfect clue about a way in which the concept of time can be addressed: time can be defined as a natural measure of the objective evolutionary process—the duration in which the universe passed from its initial ( $\Omega^{-1}$ ) to its boundary ( $\Omega$ ) state, and specified in terms of entropy-gravity coupling. Ontologically, we may say, time is a measure of transformation of cause into effect, while, speaking in more general epistemic terms, time is an imaginary mathematical quantity designed to measure the rate of change of real physical processes occurring in the universe (physically, time is manifest in its rate which is associated with the frequency-like variable known as the fine structure constant). Thus, in all quantum systems time is defined in the same way, while difference in the time-rates implies that every system operates in accordance with its own individuated local time, and that local time is

linked to the appropriately scaled strength of gravity ( $G_c = e^{\alpha c^{-1}}$ ), implying that time and gravity are in mutual exponential dependency.

### 3. Macro- and micro-units

Thus, according to our convention, the macro- and micro scales are interconnected via the genuine equilibrium of the universe linked to the electron as follows:

$$T_w \cdot G_w \cdot R_w = \Omega \quad (4)$$

where  $T_w = \alpha_w$  is a frequency-like quantity linked to the electron, further referred to as the time-rate of the electron or constant of time.

$G_w = e^{\alpha_w^{-1}} \approx 3.263 \dots \cdot 10^{59}$  is a measure of rotation of the universal quantum vortex, further referred to as the constant of gravity.

$R_w = \alpha_w \cdot e^{\alpha_w^{-1}} \approx 2.381 \dots \cdot 10^{57}$  is a measure of translation motion of the universal quantum vortex, further referred to as the constant of the universal force,  $F_w$  (which is electro-magnetic and nuclear forces considered as a single entity); equivalently, it is the radius of the universe at its genuine equilibrium  $R_w = F_w$ .

$\Omega = 10 \cdot \omega \cdot 10^{114}$  is a physically meaningful quantity that encapsulates becoming of the universe, interpreted as the duration in which the universe passed from its initial ( $\Omega^{-1}$ ) to its boundary state ( $\Omega$ ).

Following the logic of the inverse modality encoded in Eq. 3, the paper assumes that the macroscopic quantities and their microscopic equivalents are fully inversed with respect to each other; given that premise, we are able to define the micro-units of duration, mass and length as follows:  $d_w = \ln^{-1}\Omega$ ,  $m_w = \ln^{-1}G_w$ ,  $r_w = \ln^{-1}R_w$ , respectively (in what follows, upper-case letters denote the macroscopic scale of the universe, while lower-case ones denote its microscopic scale); of particular interest is that the time-rate and the mass of the electron are indistinguishable ( $\alpha_w = m_w$ ), which allows us to deduce an analytical relation between the time-rates and the masses of the elementary particles, as described below.

### 4. The electron and its radius

Formally, a mathematical relation between two variables can be written as follows:  $\frac{\alpha_w \cdot \omega}{\alpha_w} = \omega = \frac{\alpha_w \cdot \omega}{\alpha_w}$ . Clearly

enough, it is appropriate to talk here about  $\alpha_w$  and  $\omega$ , and one who sees perfect symmetry between the numbers  $\omega$  and  $e$  ( $\omega \cdot e^\omega = 1 = \omega^n \cdot e^{n\omega}$ , where  $n$  is an integer) can express the parity between the time-rate and the mass of the electron as follows:

$$\frac{\alpha_w \cdot \omega}{T_w} \cdot e^{\alpha_w \cdot \omega / m_w} = 1 = \frac{\alpha_w \cdot \omega}{m_w} \cdot e^{\alpha_w \cdot \omega / T_w} \quad (4)$$

where  $T_w$  is the time-rate,  $m_w$  is the mass of the electron ( $T_w = \alpha_w = m_w$ ), while the middle part of Eq. 4 *exactly* equals the macro-radius of the electron  $R_e = 1$ . Here we should pause to clarify the line of reasoning underpinning this deduction, and those that are to follow. In addressing micro-quantities that are commonly used in physics, we associate them with appropriate macro-variables corresponding to the genuine equilibrium of the universe, which implies that the constants of time ( $T_w$ ), gravity ( $G_w$ ) and the universal force ( $F_w$ ) are thought of as reaching their unique boundary idealized maximums. Physically, the radius of the electron is defined as follows:  $r = \alpha \cdot \lambda$ , where  $\lambda = \hbar / m v$ , accordingly, the macro-equivalent of the quantum of action is considered to be  $F_w$ , and the same variable is considered to be the macro-equivalent of the speed of light; given that  $v = c = F_w$ ,  $\alpha = \alpha_w$ ,  $m = \alpha_w$ ,  $\hbar = F_w$ , we are able to define the sought-for macro-radius of the electron as follows:  $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$ .

Given the principle of analogy, perhaps the most powerful tool of general analysis, we are able to extend Eq. 4 into the field of other elementary particles, so from Eq. 4 it follows that the time-rate and the mass of any elementary particle univocally define its radius; and it is precisely the parity of reasoning that allows us to rewrite Eq. 4 as follows:

$$\frac{\alpha_w \cdot \omega}{T_p} \cdot e^{\alpha_w \cdot \omega / m_p} = R_p = \frac{\alpha_w \cdot \omega}{m_p} \cdot e^{\alpha_w \cdot \omega / T_p} \quad (5)$$

where  $T_p$ ,  $m_p$ , and  $R_p$  are the time-rate, mass, and radius of a given elementary particle ( $p$ ), respectively.

Given Eq. 5, one can calculate the time-rates and radii corresponding to the unique masses of distinct elementary particles by substitution into Eq. 5 of appropriate values given in the units of electron-masses. As it follows from the appropriate calculations, each value corresponding to the unique mass has two real roots, so, mathematically speaking, every elementary particle constitutes a quantum system consisting of two complementary entities interconnected via the electron joint,  $R_e = 1$ , as Table I shows.

**Table I.** Time-rates ( $T_p, T_p^D$ ) and radii ( $R_p, R_p^D$ ) of certain elementary particles ( $R_e$  and  $r_e$  are electron radii at the macro- and micro-scales, respectively).

Particle	$T_p$	$R_p$	$T_p^D$	$R_p^D$
...			...	...
'Dark' proton			$\approx 0.00039\dots$	$\approx 10.43\dots$
'Dark' pion			$\approx 0.00049\dots$	$\approx 8.59\dots$
'Dark' gamma-quantum			$\approx 0.00055\dots$	$\approx 7.67\dots$
Electron (e) and its 'dark' twin	$= \alpha_w$	$= 1 (R_e)$	$\approx 0.00256\dots$	$\approx 2.84\dots$
Gamma-quantum ( $\gamma$ )	$\approx 1\dots$	$\approx 0.00414\dots (2r_e)$		
Pion ( $\pi^+$ )	$\approx 2\dots$	$\approx 0.00207\dots (r_e)$		
Proton ( $p^+$ )	$\approx 13.4\dots$	$\approx 0.000309\dots$		
...	...	...		

Thus, Eq. 5 describes a dual symmetrically inverted pattern organized in such a way that for every elementary particle its time-rate increases as its radius decreases in one quantum realm, while in the other realm the time-rate decreases as the radius increases, so, theoretically, an action in one realm consequently induces an appropriate counter-action in the other realm, in such a way that the realms can unceasingly induce each other via their common centre of symmetry, encoded in  $1 = R_e$ , an electron joint between the two realms. Step by step, physics explores the luminous low-energy micro-realm (left lower part of Table I), while its inverse remains a dark side of the universe amenable only to crude approximation. As the paper assumes, it is exactly here that algebra, literally meaning both "restoring" and "forcing", bears the potential to explain how these realms are interrelated, and it is precisely the algebraic insight proposed that lies at the heart of the research to be presented. Combined with current physical knowledge, that method allows us to deduce major dimensionless quantities of the electron (Table II). Here we should pause to explain how the velocity ( $v$ ) and the quantum of action ( $\hbar_w$ ) are defined. Velocity is defined as  $v = \frac{r_w}{d_w} \approx 2.000264\dots$  further referred to as  $\approx 2$ , which is a classical representation of velocity of a material body moving in Euclidean space (which is distance divided by *duration*); the quantum of action is defined as follows  $\hbar_w = \alpha_w \cdot \omega$ , which can be interpreted in the following way: given that  $\alpha_w$  is the reciprocal of the Compton wavelength of the electron,  $\Lambda_w = \alpha_w^{-1}$ , the paper considers  $\alpha_w$  to be its frequency-like quantity that is meant to describe temporal changeability of the universal quantum vortex, while the angular momentum ( $\omega$ , see Table II) of the electron accounts for the rotational invariance of that vortex (implying a single degree of freedom), which establishes one-to-one correspondence between *individuated* ( $\propto T_p$ ) discrete values of the quantum of action and any elementary particle as follows:  $\hbar_p = T_p \cdot \omega$ .

**Table II.** Major dimensionless quantities of the electron

Quantity	Macro-scale	Micro-scale	Source formula
Quantum of action ( $F_w, \hbar_w$ )	$\alpha_w G_w$	$\alpha_w \omega$	Eq. 2
Classical radius ( $R_e, r_e$ )	1	$\approx \frac{\hbar_w}{2}$	$r = \lambda \alpha$
Gravitational radius ( $R_g, r_g$ )	2	$\approx \frac{\hbar_w}{2}$	$R_g = \frac{2Gm}{v^2}$
Compton wavelength ( $\Lambda_w, \lambda_w$ )	$\alpha_w^{-1}$	$\approx \frac{\omega}{2}$	$\lambda = \frac{\hbar}{mv}$
Charge ( $E_w, e_w$ )	$\pm \sqrt{\Omega \alpha_w}$	$\approx \pm \sqrt{2 \alpha_w^2 \omega}$	$\hbar = \frac{e^2}{\alpha v}$

Bohr radius ( $A_0, a_0$ )	$\alpha_w^{-2}$	$\approx \alpha_w^{-1} \cdot \frac{1}{2}\omega$	$a_0 = \frac{\hbar}{mv\alpha}$
Angular momentum (for a circular Bohr's orbit, $L_e, l_e$ )	$G_w$	$\omega$	$L_e = mv a_0$
Ratio 1: quantum of action to angular momentum	$\alpha_w$	$\alpha_w$	
Ratio 2: classical radius to Compton wavelength	$\alpha_w$	$\alpha_w$	

Note that the two ratios (lower part of Table II) highlight the outstanding role of the alpha in connecting the scales of the universe via the quantum of action:  $\frac{F_w}{G_w} = \alpha_w = \frac{\hbar_w}{\omega}$  (in its turn,  $\frac{\hbar_w}{\alpha_w} = \omega = \frac{\hbar_w}{m_w}$  allows us to appreciate the role of the omega in connecting the quantum of action, mass and the time-rate of the electron); also, note that the gravitational radius of the electron is deduced from the substitutions in Schwarzschild's equation:  $G = G_w, m = \alpha_w, v^2 = F_w$  (the macro-scale) and  $G = \omega, m = \alpha_w, v^2 = 4$  (the micro-scale), respectively.

To complete this section, it would be reasonable to show how the dimensionless pattern proposed relates to dimensionality inherent in physics. In principle, if the Compton wavelength ( $\lambda_p$ ) of an elementary particle is known, one can calculate its radius as follows:  $r_p = \lambda_p \cdot T_p \cdot R_p$ , where the right-hand terms are, respectively, the Compton wavelength (dimensional), the time-rate and the radius of the elementary particle in question (dimensionless). Given Table I and the data obtained through empirical research [2], one can calculate appropriate radii, for example, for proton  $\approx \frac{0.842...}{1000}$  fm, pion  $\approx \frac{0.585...}{100}$  fm, ... electron  $\approx \frac{2.818...}{1}$  fm... anyone capable of multiplying can continue making up this set; what should be kept in mind is that the calculations are apparently rude, but taking into account their illustrative purpose and the rude approximation of  $\alpha$ , the outcome can be considered relevant to empirical evidence, and, of course, the scale coefficient of the universe, a *factor of ten*, should be taken into account.

## 5. The fundamental interactions

Commonly, physical interactions are interpreted as arising from differences in energy levels between the elementary particles with a universal tendency to the lowest energy level, that is, to equilibrium. Given that the concept of time-space is central to physical reality, it would be reasonable to assume that the fundamental physical interactions might be based on the relationship between the space-like (the Compton wavelength,  $\alpha_w^{-1}$ ) and the time-like (the time-rate,  $\alpha_w$ ) quantities of the electron, which, it must be said, constitute a complementary pair: each member of this pair describes the fundamental aspect of the electron that the other ultimately misses. Given that  $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$  is a mathematical manifestation of physical equilibrium, and drawing on Table I, it would be logical to assume the following: if the value of the Compton wavelength increases then the value of the time-rate decreases, and strong forces act (they conserve the atom's integrity, and provoke gain in gravity), otherwise weak forces act (they stimulate nuclear decay, and compensate gain in gravity). Once accepted as a guess, albeit one which is attended by a certain logic, this claim must be given a concrete physical footing, which will be our concern below.

As it follows from Table I, four remarkable elementary particles define the ranges of three physical forces which are manifest in the time-rates and corresponding radii for: (i) electro-magnetic forces acting within the  $e$  and  $\gamma$  layers ( $\alpha_w, 1$  and  $1, 2r_e$ ); (ii) strong forces acting within the  $\gamma$  and  $\pi^+$  layers ( $1, 2$  and  $2r_e, r_e$ ); and (iii) weak forces acting beyond the Yukawa potential restricted by the  $\pi^+$  and  $p^+$  layers, where the latter (the proton-layer) ultimately closes the gravity feedback loop through the radius of the proton and that of the void particle as follows:

$$R_{proton} \approx \frac{\alpha_w}{R_w} \cdot 10^{56} = \frac{1}{G_w} \cdot 10^{56} \quad (6)$$

The model proposed makes it clear that the electro-magnetic and nuclear forces can be thought of as a single quantum vortex in which all its constituents (the elementary particles) are distinguished in terms of their time-rates (equivalently, in terms of their quanta of action). Due to instabilities permanently occurring in real inhomogeneous physical medium it takes different delays to generate a feedback signal linked to the radius of the void particle; meanwhile, the quantum objects are free to shift, rotate, contract-expand, and tend to scattering, which is manifest in time-symmetry violations observed at the scale of the weak interactions; as it follows from Table I, it is precisely this layer that constitutes the *weakest* link in the gravity feedback loop as against the strict determinism inherent in the electro-magnetic and strong forces layers, which is manifest in the appropriate symmetries (Table I).

## 6. Time, finiteness, and infiniteness

To gain a deeper mathematical insight into the structure of the time-space continuum, it would be reasonable to take a closer look at the Lambert function. Along the real axis at the interval  $(-\infty, -e^{-1})$  the function is widely discontinuous, while for  $x > -e^{-1}$  it vanishes identically, which means that the function values are considered to be zero. The paper assumes that this zero is ontologically relevant to a physical nothingness, implying a primordial quantum dipole which is manifest in the radius of the void particle  $\pm r_0$ . Of particular interest is that the construct suggested is amenable to interpretation in terms of quantum mechanics: at the interval  $-e^{-1} < x < 0$  the Lambert function has two values which are always anti-symmetric relative to its branch point  $(-e^{-1})$ ; this feature of the Lambert function makes it possible to address void splitting in terms of chirality, which means that the universal quantum vortex can be conceived as an ensemble of mathematically interconnected quantities consisting of chiral quantum twins: deriving from the same argument, two complementary anti-symmetric function values can be associated with the members of an entangled quantum pair, thus entailing that both members of the pair are identifiable independently via their common *causal* variable—their common argument, implying their common ground state that is relevant to their common ontic cause (in what follows, the original term “entangled” (implying quantum entanglement) will be used though it should be perfectly clear that its exact epistemic opposite is meant—completely disentangled quantum information).

Thus, the pattern implies that both right- and left-handed physical realms are possible. Clearly enough, no flesh-and-blood observer can exist in both realms simultaneously, so from the standpoint of such observer, void can be extruded from its ground state either through clockwise or counter-clockwise rotation but not through both (which is precisely what Pauli’s exclusion principle tells us: two fermions can occupy the same orbit as long as they spin around their own axes in opposite directions). Deriving, mathematically, from common argument and exhibiting consistent mirror anti-equality, the members of the same entangled quantum pair have no alternative but to be, physically, in opposing quantum states simultaneously, therefore for a hypothetical Schrödinger’s cat quantum situation is always, literally, half-certain, and the same holds true for his or her fellow-cat marked with opposite handedness and entangled in the same quantum non-locality. Among other things, that pattern explains the matter-antimatter asymmetry paradox: due to the initial conditions species marked with a particular initial handedness will ineluctably become dominant, therefore in each realm conventional electrons far outnumber conventional positrons which can be depicted as the electrons that rotate in opposite direction, that is, move as if backward in time; of particular interest is that physics recognizes an epistemic connection between direction of time and direction of rotation of the fermions, which, it may be remarked, underlies the concept of time proposed (thus, we may repeat, time is an imaginary mathematical quantity that is designed to measure direction of rotation and rates of change of real physical processes occurring at all scales of the universe: from weak interactions that recognize a distinction between left- and right-handedness to cosmic parity violation associated with spiral galaxy spin asymmetry).

Now, we approach perhaps the most esoteric aspect of ontic knowledge—a nexus between finiteness and infiniteness. The point is that the construct suggested allows for *infinite* number of causal variables within the *finite* interval  $x \in [-e^{-1}, 0]$ , which implies that information diversity arising from chaotic void is amenable to constraints, which is precisely what Eq. 2 means: it describes appropriate feedback loop, thus making it clear that infinite branching of the quantum continuum is physically impossible. Of particular relevance for physics is that the construct in question is amenable to consideration in terms of a connection between the fermion-like and the boson-like behaviours. The point is that the fermions can be thought of as non-integral values the Lambert function takes for the same argument  $x \in [-e^{-1}, 0]$ , which implies half-integer values of the fermion’s spins and single degree of freedom associated with the fermion asymmetric behaviour. However, for the same argument (even if it is not a complex number) there exists an *infinite* number of complex multiple-valued solutions  $W_n(z)$ , where  $n \in \mathbb{Z}$  (all integers positive and negative:  $-\infty \dots -2, -1, 0, +1, +2 \dots +\infty$ ); according to our convention, this implies integer values of the bosons’ spins and multiple degrees of freedom associated with bosons’ symmetric behaviour. Accordingly, the dynamics of the universal quantum vortex can be depicted as a persistent ramification of causal chains arising via the  $r_0$  –correlated fermion-like finite chiral discrete distribution of primordial quanta amplified by oppositely directed higher order boson-like correlations limited from above by  $\mp R_w$  ( $\pm r_0$  is its low limit; also, this limit can be defined in terms of the proton radius (Eq. 6) as well as via the branches of the Lambert function:  $\mp \frac{W(\pm 0_w)}{W_{-1}(-0_w)} \cdot 10^{56}$ ). To this, it may be added that the construct proposed is fit perfectly to piece together topology, time and cause: the fermion-like distribution of primordial quanta implies causality and closureness; the boson-like higher-order correlations imply openness and a complete set of effects linked to infinite variety of causal variables, implying the plenitude of all possible quantum states arising from chaotic void (not only does this allow us to

distinguish between past and future, this allows us to link such distinction with a concept of individual monadic will, associated with the fermion's behaviour). Mathematically, we may say, the fermion-boson interaction ensures an absolutely gapless causal nexus between the past and the future quantum states of the universal quantum vortex; arising via entropy-gravity coupling, all quantum states are manifest in appropriately scaled equilibriums  $G_c = e^{\alpha c^{-1}}$ , and all these equilibriums are encapsulated in the Janus-like equation that connects the initial and boundary conditions of the universe:  $\ln\Omega^{-1} = -\ln\Omega$ , which is exactly what the concept of time implies. Of particular relevance to this concept is that the inverse of the "big omega" ( $\Omega^{-1}$ ) coincides with the micro-unit of duration, reversed in sign ( $-d_w$ ), which, of course, does not mean that time may flow backward, what this means is that the concept of time is usable to measure both duration and direction of physical processes as against the two unique counter-states of the universe:  $\Omega^{-1}$  and  $\Omega$ .

## 7. Null and zero

Thus, we may say, the pattern describes a primordial cosmic womb that gives birth to matter orderliness, arising from the distribution of the causal variables over the real axis. This, however, is one side of a cosmic dialogue between the fermions that crave infinity and a power that seeks to restrict such craving; mathematically, it is the axis of imaginaries that allows both sides of the dialogue to be recognized and appreciated. The point is that a distinct entangled quantum pair can be thought of as representing a completely reversible system in which information that determines both members of the pair comes for free, that is, acquisition of information in this case does not change the entropy of the system, which is physically relevant to a complete compensation of contra-rotating quantum vortexes linked to different members of the same quantum pair. Clearly enough, in this case all primordial causes (ground states) are simultaneous with their immediate mutually complementary effects that are encoded in the function values associated with the members of the same quantum pair (note that this *modus operandi* of quanta implies a principle of included third that is fundamentally different from the principle of excluded third which underlies both classical logic and the logic of today's physics). It is increasingly clear that the pattern reveals two modes in which quantum information can be managed; one mode is marked by simultaneous causation, reversibility, symmetry, homogeneity and continuity, while another implies exactly the opposite: sequential causation, irreversibility, asymmetry, heterogeneity and discreteness. Accordingly, the former is associated with the concepts of null and *spurious* infinity, while the latter with the concepts of zero and *genuine* infinity; it is precisely zero that is meant to quantify primordial undifferentiated void, thus yielding its sequential quantum distribution which is manifest in causal order of primordial quantum events coupled to zero, while null is meant to restrict this process in time. Accordingly, it is the conjunction between the real axis and the axis of imaginaries that allows both frameworks and corresponding reference points to be described in terms of symmetry-and-asymmetry complementarity:  $W(-e^{-1}) = -1$  vs.  $W(e) = 1$  with  $W(1)$  vs. 0 at the core of this twist-like mapping.

Of particular interest is that the model proposed makes it possible to take a new look at the Higgs mechanism of mass formation (to remind, the standard model requires the Higgs particle to be a zero-spin *super-massive* gauge boson mediating with mechanical forces through a *massless* particle with the spin of 2). According to our convention, there is *only* one zero-spin particle that determines the genuine equilibrium of the universe—the void particle of  $r_0$  –radius. Given that both fermions and bosons tend to equilibrium, there is no option other than to agree that the sought-for mysterious *massless* particle with the spin of 2 and the long-sought *super-massive* zero-spin Higgs boson are one and the same quantity—the gravitational radius of the electron:  $R_g = 2R_e = 2$  at the macro-scale, while at the micro-scale its value *exactly* equals the classical radius of the electron:  $r_g \approx \frac{\hbar_w}{2} = r_e$  (Table II). The former relation implies that the gravitational radius of the electron contains twice the physical degree of freedom of the ordinary electron, which accounts for the claim that the ultimate reality consists of two contra-rotating quantum vortexes associated with two physical realms marked with different handedness (in what follows, the term "ultimate reality" means that both left- and right-handed realms are taken into consideration); the latter relation implies that shape of every real object, in each realm, is determined in terms of gravity via the quantum of action  $\hbar_w$ , equivalently, via the classical radius of the electron  $\frac{\hbar_w}{2}$ . Considered in their totality, both relations imply that it is precisely the electron that lies at the core of physical connection between gravity, electrodynamics and nuclear interactions, thus ensuring a link between the quantum and cosmological scales of the universe. Speaking in more general epistemic terms, this claim implies a complete congruence between the form (which is manifest in the radius of the electron) and the content (which is manifest in ever changing quantum information associated with fermion's behaviour), and this is exactly what the term "information" encapsulates. To complete this thought,

irreducible randomness inherent in chaotic void is an inexhaustible source of natural informational diversity, and it is precisely the  $\omega - \alpha$  relationship (implying change-and-invariance) that determines structural limits of quantum information exchange within the time-space continuum, which, in particular, means that the universe cannot be infinite in both time and space; it is either spatially unrestricted timelessness or eternity that implies infinite existence of time-space.

Topologically, the pattern described is tantamount to behaviour on a twisted surface on which it takes two circuits ( $4\pi$ ) to return to the original orientation of the primordial quanta, thus completely compensating the contribution of their zero-point energies; physically, this means that the fermions return to their original orientation after  $4\pi$ -rotation, which is exactly what Eq. 3 claims:  $\mp R_w = -W^{-1} (\pm R_w^{-1})$ . Since all ground quantum states are mathematically identifiable, and the appropriate *individuated* information remains unchangeable under any physical transformations, no information linked to the fermions can be lost (note that invariance of a physical quantity under infinite transformations is manifest in the following remarkable feature of the exponent function:  $f'(e^x) = e^x$ ). Undoubtedly, this is an inestimable property of continuous mathematics, but, as this paper hopes to explain, such mathematics does not allow the ultimate reality to be properly addressed, therefore a question remains to be answered: Can quantum states of the ultimate reality be described in terms of discrete mathematics? It is increasingly clear that it is the octonion numbers that are fit perfectly to meet that challenge; these numbers are neither real, nor commutative, nor associative, which accounts for time, irreversibility and causality, respectively. So, if the book of nature is written in the language of numbers, then the real numbers describe one-dimensional spatial distribution of quanta over the real axis, the imaginary numbers stand for imaginary time, the complex numbers describe two-dimensional quantum distribution over the plane of space-and-time, the quaternions signify three-dimensionality, rotation and irreversibility of that triadic entity, but ultimately it is the octonion algebra that explains how causality pieces all these entities together. Such pattern can be described as follows:

$$\Delta + Ti + Gj + Fk + \delta + t_c il + m_c jl + r_c kl = e_c \quad (7)$$

where  $\Delta$  is a real number that stands for the value of displacement (relative to the genuine equilibrium), while its sign denotes handedness of a macro-object in question;

$T, G, F$  are real numbers corresponding to the constants of time, gravity, and the universal force, respectively (if  $\Delta = 0$  then  $T = T_w, G = G_w, F = F_w$ , otherwise  $T = T_c, G = G_c, F = F_c$ );

$\delta$  is a real number that stands for the value of displacement (relative to the genuine equilibrium), while its sign denotes handedness of a micro-object in question (if  $\Delta = 0$ , then  $\delta = 0$ );

$t_c, m_c, r_c$  are real numbers corresponding to the time-rate, mass and radius of the micro-object coupled to appropriately scaled equilibrium; if  $\delta \neq 0$  then  $t_c = \alpha_c$ , otherwise  $t_c = \alpha_w, m_c = m_w, r_c = r_w$ .

$i, j, k, l$  are imaginary units such that:  $i^2 = j^2 = k^2 = l^2 = -1$ ;

$e_c$  is a numeric value that is meant to describe event associated with the quantum object in question.

Thus, Eq. 7 describes a way in which physical (and logical) integrity of the time-space continuum is ensured: gravity (guided by the principle of the angular momentum conservation) gives shape to formless void by forcing time ( $\alpha_c$ ), space ( $r_c$ ), and matter ( $m_c$ ) to couple with each other according to the principles of causality, least time and least action. Given such insight, one readily understands how gravity and geodesic are interrelated, and it is precisely the gravity-mass connectivity highlighted that makes geodesic relevant for physics—time forces quanta to gravitate towards the points of their self-similarity (their origin) in the shortest way possible.

From the above, in particular, it follows that the genuine cause of the quantum indeterminacy is the irreducible randomness inherent in ceaseless rotation of chaotic void, which is manifest in permanent entropy variations counterbalanced by gravity according to the following relation:  $T_c A_c = \text{const} \propto R_c$ , which means that for a quantum object a change in the time-rate inevitably results in corresponding change of the Compton wavelength (and vice versa), therefore, it is impossible to *measure* simultaneously both temporal and spatial quantities of the object in question (which, however, does not entail that it is impossible to *know* these quantities: we cannot measure simultaneously both variables that constitute an entangled quantum pair, but, as the pattern explains, we are able to know them). Thus, until both right- and left-handed realms are considered in their ontic totality, Heisenberg's principle remains a fundamental physical indeterminacy in each of the realms. Also, it is appropriate to remark that current physics, for obvious reasons, applies Hamiltonian-based formalism to describe relative quantum states rather

than to describe these states within the frames of the whole time-space continuum; and it is precisely Eq. 7 that hopes to fill this “void” through the variables that describe the macro-scale of the universe. What may be emphasized here is that these variables are relevant to the elements of the main diagonal in the quantum chromodynamics (QCD) matrix; contemporary physics considers these elements functionless on the basis of their “colourlessness”, which reflects the core conceptual restriction of Newtonian physics: darkness is the absence of light. Full stop.

## 8. Primordial helix

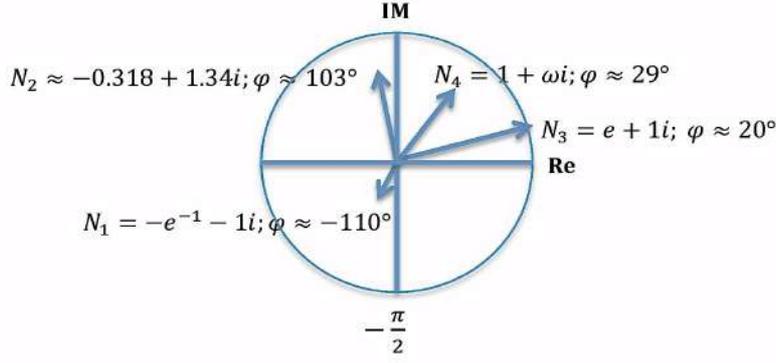
To gain a further insight into the role of the dark domain of the universe and the origin of its initial energy, it makes sense to take a closer look at Boltzmann’s entropy formula  $S = k \cdot \ln W$  (though there is a certain amount of confusion about the term “entropy”, modern science consistently distinguishes two its aspects: thermodynamic and informational—this paper considers the former as an external manifestation of the latter). Drawing upon Boltzmann’s formula, one can calculate: (i) the entropy of the universe at its genuine equilibrium:  $S_w = G_w$  (in this case the universe is considered to be a single macro-object, and Boltzmann’s constant ( $k$ ) is considered to be an appropriately scaled quantum of action, i.e.,  $F_w$ ); and (ii) the entropy of the electron at its genuine equilibrium:  $s_w = \omega$  (in this case the electron is considered to be a micro-object, and, appropriately scaled, Boltzmann’s constant takes the value of the quantum of action at the micro-scale, i.e.,  $\hbar_w$ ); in both cases  $W = G_w$  which is considered to be a number of all possible quantum states related to the electron at the point of the genuine equilibrium of the universe. Given Boltzmann’s insight, we are able to connect entropy and gravity via the angular momentum of the electron as follows:  $\frac{S_w}{s_w} = N_w = \frac{G_w}{\omega}$ , where  $N_w = \frac{F_w}{\hbar_w}$  is a quantitative measure of quanta of action linked to the electron at the genuine equilibrium of the universe. Considered in terms of the logarithm function, the same relationship can be written as follows:  $\ln \frac{S_w}{s_w} = A_w + \frac{r_w}{d_w} \lambda_w \approx A_w + 2\lambda_w$ , where  $A_w$  and  $\lambda_w$  are the Compton wavelengths of the electron at the macro- and micro-scales, respectively (Table II). Next, Boltzmann’s formula allows us to calculate the initial entropy of the void particle as follows:  $S_0 = \alpha_w^{-1}$  ( $k = 1$ , which means that void itself produces no translational motion); in what follows,  $S_0$  will be referred to as the free entropy of the void particle, equivalently, its gravitational potential.

Now, the formalism of physics challenges us to describe entropy in terms of thermodynamics, that is, to connect entropy with temperature. In this particular case we can reasonably apply the method of extreme values; accordingly, two quantities should be considered: (i) the entropy of the universe at its genuine equilibrium (the amount of bounded information corresponding to that state,  $S_w = G_w$ ,  $s_w = \omega$ ), and (ii) the free entropy of the void particle (the corresponding amount of unbounded information). The sought-for ratios are as follows:  $T_w^\circ = \frac{S_w}{S_0} = F_w$  and  $t_w^\circ = \frac{s_w}{s_0} = \hbar_w$ . As it follows from these relationships, temperature is a thermal equivalent of the quantum of action, which is amenable to reason: What is heat, as measured by a thermometer? It is a force that moves the mercury a certain distance. Given such insight, it makes sense to take a closer look at the physical quantity that is used to measure the thermal responsiveness of a physical system, and commonly referred to as the time-constant ( $\approx 36.8\%$ ). It is easy to see that this quantity draws on the factor of  $e^{-1} \approx 0.368$ , which is well known to electrical engineers as the duration it takes the output of an electric process to change by  $\approx 63.2\%$  of the peak-to-peak amplitude on every transition; what is more, this value is also well known to mathematicians as the probability ( $\approx 63.2\%$ ) that a permutation of many elements will have at least one fixed point (an element equal to its image), which implies invariance of a physical quantity under infinite transformations (as noted, this is manifest in the following remarkable feature of the exponent function:  $f'(e^x) = e^x$ ). Given certain functional versatility of  $e^{-1}$ , it would be reasonable to assume that this value might be somehow connected with a fundamental pattern underlying physical reality. The line of reasoning proposed allows us to describe this pattern in terms of the following recursive discontinuous transformations:

$$\begin{array}{l}
 -x^{-1} \quad \mapsto W(-x^{-1}) = -1 \mapsto W(-1) \mapsto a\text{-point } (\rho \approx 137 \cdot 10^{-2} \text{ and } \varphi \approx 103^\circ) \\
 \updownarrow \\
 x \quad \mapsto W(x) = 1 \mapsto W(1) = \omega \mapsto \omega\text{-point } (1 + \omega i)
 \end{array} \tag{8}$$

where  $x = e$  is the base of natural logarithms;  $A \mapsto B$  reads as A gives rise to B; the two different forms (polar and rectangular) that describe the endpoints of the  $\alpha$  – and  $\omega$  –branches of the expression (8) are used for a clearer presentation of this double helix pattern.

**Fig. 1.** The initial twist of the double helix pattern.



The upper,  $\alpha$  –branch, of this pattern defines the time-rate of the proton ( $\Im(N_2) = T_{proton} \cdot 10^{-1}$ ), and the inverse time-rate of the electron ( $\text{mod}(N_2) = \alpha_w^{-1} \cdot 10^{-2}$ ), scaled in accordance with the factor of ten; multiplying the boundary numbers of the pattern we obtain the radius of the proton scaled in accordance with the same factor of ten:  $N_1 \cdot N_3 = (-e^{-1} - 1i) \cdot (e + 1i) = -(e^{-1} + e)i$ , or in terms of polar coordinates:  $\rho \approx 3.09 \dots \approx R_{proton} \cdot 10^4$ ;  $\varphi = -\frac{\pi}{2}$  (emphasis added; to recall,  $R_{proton}$  corresponds to the point of reverse of the universal quantum vortex, as Eq. 6 describes). Thus, the pattern immediately yields the time-rate and radius of the proton as well as the inverse time-rate of the electron scaled in accordance with the factor of ten (the logic of the present research makes it possible to assume that this renormalization factor is an arithmetic simplification of  $\pi^2$  interpreted as the arc length (half wave-length) corresponding to the central angle of  $180^\circ$  given the following invariance  $r = \pi$ , which encapsulates a concept of absolute energy conservation). Also, the pattern immediately yields the radius of the “dark” electron:  $R_e^D = T_0 \cdot e^{T_0^{-1}} \approx 2.84 \dots$ , where  $T_0 = \alpha_w^{-1} \cdot 10^{-2} \approx 1.37 = \text{mod}(N_2)$ , thus implying that the hydrogen atom is an indivisible whole underlying the entire physical structure of the universe, and it is precisely in that conceptual sense that we should understand the claim by Democritus that atoms are indivisible structures, but not in the sense that no atom can be broken into smaller bits.

### 9. Inverse mode

Now, it is possible to connect the primordial discontinuity described (Fig. 1) with the inverse mode inherent in the quantum gravity loop. It is true that the electro-magnetic force has never been observed to flow backwards, but it is also true that physics consistently distinguishes between the two, negative and positive, electric charges; this paper defines them as follows:  $\pm\sqrt{2\alpha_w^2\omega}$ , where the plus-minus sign stands for the conservation of the electric charge, which is relevant to the conservation of the universal quantum vortex: the amount of void to be absorbed (into the gravitational contour of the universe) and the momentum to be generated (inside the contour) should equal each other. Thus, we may say, the “electric field” is a result of continual alternation of opposite charges arising via the permanent reconfigurations of contra-rotating constituents of the universal quantum vortex around the genuine equilibrium (accordingly, the electric charge invariance is relevant to the law of angular momentum conservation, which is manifest in the mathematical constancy of the angular momentum of the electron  $\omega$ ). Also, it is safe to say that the bi-polar nature of the electric charge  $\pm\sqrt{2\alpha_w^2\omega}$  traces back to the primordial discontinuity of void ( $x \in [-e^{-1}, 0]$ , see Fig. 1), which is mathematically relevant to the discontinuity of the square root function, implying the contra-rotating quantum vortexes arising from the initial chiral separation of void. At the quantum scale the discontinuity in question is manifest in the collapse of the wave function; however, in an attempt to escape negative probability (as physically meaningless) physicists traditionally describe the probability of a quantum event as the modulus squared of its amplitude. Accordingly,  $|\psi|^2$  probability law holds true since it is governed by the strict probabilistic principle underlying the structure of the ultimate reality (36.8% vs. 63.2%, that is,  $(W(e) - e^{-1})$  vs.  $(-e^{-1})$  relationship); and it is precisely the operation of squaring that sweeps quantum discreteness under the rug, thus making it mathematically unfathomable in principle to address the primordial quantum discreteness in a physically meaningful manner. Thus, when a real process tends, mathematically, to 0, this means that, physically, it tends to the point of the genuine equilibrium which is relevant to quantum chirality swap ( $\pi$  –turn); in this case, the

sign of the mathematical function involved reverses, while 0, as prescribed by the syntax of mathematical analysis, escapes to  $\infty$ , thus leaving physicists unaware of the genuine cause of the wave function collapse—indeed, we observe reversals of physical processes rather than collapses of the wave function. That is why traditionally educated physicists are unable to gain deeper insight into the inverse modality of nature, while there is a growing body of evidence suggesting that such mode lies at the core of all physical processes, irrespective of their external manifestations. Take for example our everyday experience, say, when kids break a double-glazed window with a soccer ball; if the blow is sharp enough, only the inside pane is broken, while the outside, as against immediate apparentness, is not. The same inverse mode also explains, for example, the phenomenon of “negative pressure” occurring in trees: as if against the law according to which a mysterious apple fell, allegedly, on Newton’s head, liquids rise from roots to shoots ... one can easily continue this list including in it capillary attraction; hurricanes that rotate counter-clockwise in the northern hemisphere and clockwise in the southern hemisphere... As a step towards further understanding of the inverse *modus operandi* of the universal quantum vortex, it will perhaps be helpful to take a closer look at the pattern of radiation exchange between interstellar void and the Earth. As the model explains (Table I), the luminous and dark domains of the universe are interconnected via the electron joint  $R_e = 1; r_e = \frac{\hbar_w}{2}$  or, if one likes, are separated by the light barrier; in the neighbourhood of this special limit the strength of gravity steeply increases as the time-rate decreases in the same jump-like manner (Table I), which, according to our convention, implies that time slows down. Given such darkness-and-light ontic complementarity, we are able to claim that the elementary particles do not *travel* billions of light-years across the universe before arriving on the Earth—as the angular momentum of the electron approaches  $\omega$ , it is the interstellar void that takes the form of such particles, as Eq. 5 describes. Thus, the term “elementary particle” is meant to describe the well-defined locales of the universal quantum vortex, encoded in terms of the individuated quanta of action ( $\propto \hbar_w$ ) that are manifest in the frequencies and radii of the elementary particles. Clearly enough, the individuated values of the quantum of action allow all constituents of the quantum vortex to be kept apart as they either replicate ordinary matter in the luminous domains of the universe or gravitate towards its dark domains (which, in particular, explains why the universe unfailingly avoids the ultraviolet catastrophe). Thus, when we look at the stars we see their twice inverted images that are manifest in double finely calibrated aberrations—the starlight observed is accurately twisted and untwisted as the universal quantum vortex passes through the dark domains of the universe (so, it is not for nothing that the word “cosmos” means both “orderliness” and “decoration”). Next, when cold quantum vortex enters the Earth’s atmosphere, it gradually warms itself as it penetrates into denser and denser layers of the material shell of the planet. First, the inverse modality is manifest in the temperature inversion layers, implying divergence *vs.* convergence air displacement; as appropriately scaled time-rates of the constituents of the quantum vortex coherently change, the Earth’s layers are subject to temperature variation, but the total entropic balance remains practically unchanged since the whole process runs via a series of finely calibrated intermediate entropy-gravity equilibriums. Progression of these equilibriums ensures continual alternation of heating and cooling phases, which allows individuated frequency separation of the quantum flux to be effectively leveraged, therefore, higher-energy hotter quanta escape the surface of the planet, while colder lower-energy ones remain until a thermal equilibrium is settled (*alcarazza* is a good illustration of that process: *alcarazza* is a porous ceramic vessel used to *cool* liquids in hot countries—it is precisely exposed *porosity* that diversifies energy-information channels, which allows individuated frequency separation of the quantum flux to be leveraged in the best way possible). Certainly, all that effective work against dense matter (in atmosphere, hydrosphere, and lithosphere) cannot be done without transfer of force. Such transfers are manifest in short-periodic solar bursts, and long-periodic magnetic field reversals underlying the switches of solar storm direction which are observable on the sun; of particular interest is that the same coronal mass ejections that heat the upper atmosphere of the Earth also trigger chemical reactions that quickly cool it (thermospheric overcooling); on the Earth such force transfers are manifest in different forms of thermal whirlwind-like phenomena such as hurricanes or earthquakes, which is consistent with the geological-physical paradigm known as rotational geodynamics claiming that lithospheric plates constantly rotate, implying that ultimately it is gravity that determines the geological landscape of the Earth. Exposed to persistent mechanical stress, ordinary matter persistently splits; this is manifest in crystal dislocations occurring until a single crystal loses its individuated identity and becomes a polycrystalline specimen; of course, the more diversified a system, the more it is resistant to destruction: sufficiently diversified energy-information channels allow surface excess entropy to be effectively dissipated, for example, tropical forests show more ability to cool themselves as compared to homogeneous deserts, but ultimately ageing of matter is irreversible—as the surface of a distinct planet becomes

more uniform it needs less entropy supply to stay in equilibrium, accordingly, the planet rotates slower, implying that its information diversity reduces, which is manifest in gravity decrease as  $\alpha_c$  tends to  $\alpha_w$ .

### 10. The cosmological constant problem

Perhaps it is clear that it is exactly 0 that is playing a game with physicists: making no distinction between null and zero, they explore reality in a rather contradictory manner: in addressing natural phenomena arising from the pattern of sequential causation, physicists rely on its exact opposite—simultaneous causation coupled to infinitesimal calculus that underlies a dummy model of physical reality. Creating an illusion that both space and time ( $dx, dt$ ) vary *ad infinitum*, that model leaves physicists no choice but to address both time and space in terms of the same [spurious] infinity, thus making it unfathomable in principle to establish a causal relationship between these entities. Here it would be appropriate to make a historical remark: evolving away from Newton’s *Principia*, relativistic physics truncated Newton’s concept of time and space, which is manifest, in particular, in putting “time” and “space” on equal causal footing—since then physicists have been destined to simulate time rather than quest for its nature, and origin. All consequences of that historical step have yet to be assessed though the logic of evolution is obvious, and in a sense, impartial: he who does not appreciate distinction between eternity and infinity will hardly need to distinguish between time and duration (the distinction, though, lies on the surface of infinitesimal calculus: a differential time  $dt$  assumes that it is to be integrated into some “total time”, as though this “total time” were infinitely divisible, which is true only if this “total time” is supposed to be an unending time-like entity, that is, duration; duration, we may say, is causeless time, timelessness.). It is increasingly clear that physicists of today consistently apply duration (Newton’s absolute time) disguised as common time (Newton’s relative time), while these two entities are mutually equivalent *only* on an infinite interval on which gravity and entropy are mutually equilibrated with accuracy of 0 at every interstice of that interval, or speaking in more general epistemic terms, such equivalence holds true until one makes no distinction between real and imaginary entities, which is why physicists, in their quest for a final theory, repeatedly end up with nothing (in the sense of null). However, such logical blunder may go unnoticed unless we explore material worlds where gravity gradients, at least at the scale of the electromagnetic and strong forces, are finely equilibrated (see Table I), but nothing (in the sense of zero) backfires entirely when it comes to a connection between the cosmological and quantum scales of the universe, which is why physicists of today are confronting a big problem—the cosmological constant problem.

The difference ( $\approx 4 \cdot 10^{-8}$ ) between  $\alpha_c$  and  $\alpha_w$  testifies that the universe is slightly lop-sided relative to its genuine equilibrium that is associated with perfect flatness and absolute motionlessness. Given that difference, we are able to assess the local curvature of the universe:  $\frac{R_c}{R_w} \approx 1.000746 \dots$  given  $\alpha_c \approx 7.29735 \dots \cdot 10^{-3}$ ; from this, in particular, it follows that the universe is very close to being flat but is not completely flat, which is relevant to the following relation:

$$\frac{R_w}{r_0} = \Omega \quad (9)$$

This equation connects the minimum energy quantum ( $r_0$ ) with its maximum ( $R_w$ ), and it is precisely this connection that lies at the heart of the cosmological constant problem. It is manifest in impressive discrepancy between observed and theoretically estimated zero-point energy: roughly 120 orders of magnitude, according to theoretical physics, while, according to Eq. 9, it is closer to  $\Omega = W(1) \cdot 10^{115}$ , which means that physicists, strictly speaking, missed nothing—indeed, they have long been turning a blind eye to the following apparent desideratum: How can it be that *infinitesimal length*, according to Newton, is *smaller than any finite quantity, but greater than zero*? Now, this long-neglected epistemic gap entirely backfires: Eq. 9 quantifies this effect with the accuracy of zero. With this in mind, one readily understands that physicists have long been confronting zero, spatial limit of the universe; marked with chirality and impressively exaggerated in scale, it is manifest at all scales of the universe: from weak interactions that recognize a distinction between left- and right-handedness to cosmic parity violation associated with spiral galaxy spin asymmetry—it is precisely chiral representation of void splitting that allows us to claim that all quantum structures of the universe should ultimately rotate either clockwise or counter-clockwise. Given that insight, we are able to explain why the solar system has the preferential, conventionally, counter-clockwise rotation (also, the model explains why both clockwise and counter-clockwise rotations inside a star system are possible). Next, since for every “micro” there is a “macro”, there should exist a preferential opposite direction, clockwise rotation, at the cosmological scale: astrophysical observations point to such a phenomenon in

the direction of the north pole of the Milky Way. Accordingly, if the radius of the electron conducts itself as an attractor in the micro-realm, then there should exist a complementary attractor in the macro-realm: astrophysical observations confirm the existence of such an object (dubbed the “great attractor”) on the other side of the Milky Way. Accordingly, the parity violation inherent in the weak interactions should manifest itself on the cosmological scale; now, we have sufficient grounds to assume that this violation is relevant to entropy-gravity symmetry violation, and, highly likely, the slight lop-sidedness (dubbed the cosmic “axis of evil”) observed on the very large cosmological scale owes its origin to this symmetry violation as applied to the macro-scale of the universe.

Next, given that rotation is prior to translation, we are able to claim that it is precisely rotation that causes the red and blue spectrum shifts associated with translational motion of physical entities, which makes it possible to reconsider the concept of the expanding universe. According to current physics, the red shifts are evidence of galaxies’ recession, and, on the basis of this claim, it is argued that the entire universe is expanding. Though the rationale behind this claim is plain, it nevertheless remains a rather incautious extrapolation, particularly in view of the fact that relativistic physics postulates that everything moves away from everything else... including, in theory, blue-shifted cosmic objects such as the nebula of Andromeda, let alone that an ever expanding universe does not allow ordinary matter to be formed since nuclear fission is inconsistent with unlimited and uncompensated expansion of void—in that case a conflict between entropy and gravity is *always* settled in favour of entropy, implying an ultimate death of the universe—a state of *null* activity, an absolute thermodynamic equilibrium. However, both the laws of thermodynamics and empirical evidence testify in favour of life: matter exists, atoms split and the masses of the elementary particles are still definable in terms of finite information (we assume that matter derives its existence from assembly and rarefaction of extremely small but spatially finite void particles). Given that the universe expands, credible cosmological models have to rely on a non-zero cosmological constant, though, here it would be reasonable to use here the term “non-null”; as this paper hopes to explain, the semantics of nothingness also matters when it comes to understanding how physical reality is organized: zero implies genuine infinity (associated with the laws of thermodynamics), while null implies spurious infinity (associated with Newtonian physics), which is why physicists repeatedly fail to piece together reality and its simulation created by null disguised as zero. Metaphorically speaking, null hides the horse (cause) behind the cart (effect), but once this is distinguished, everything falls into place: Achilles, after all, can catch up and surpass the tortoise, while it is only in the minds of true mathematicians that decimals may continue eternally—mathematician’s meat is physicist’s poison. And until this fundamental distinction remains unappreciated, physicists are destined to choose between the three mutually exclusive scenarios: the universe either expands (openness) or collapses (closure), otherwise it is flat and motionless, and neither the logic nor the mathematics of theoretical physics allows this irreconcilability to be resolved. Seeking as it does to convert this incompatibility into complementarity, we consider all three scenarios in their ontic cohesiveness, which, in particular, allows us to claim that cosmic structures neither recede away from each other nor approach each other—basically, they rotate within the boundaries adjusted in accordance with the real fulcrum of the universe, its genuine equilibrium. From this, in particular, it follows that matter-radiation content of the universe is strictly balanced, and this balance is maintained via finely calibrated rotation of cosmic structures—marked with different rates and different handedness, this rotation is manifest in the redder or bluer spectrum shifts at all scales of the universe. Clearly enough, that model allows us to reveal how matter and radiation are counterbalanced without the necessity of knowing the exact chemical structure of the dark substance: if a luminous quantum object violates parity as related to the real fulcrum of the universe then the surrounded dark substance seeks to counterbalance this violation, as Eq. 5 describes. The same is true as regards a luminous object marked with opposite handedness, since it undergoes the same changes relative to the same invariance, namely, decrease (increase) in the time-rate corresponds to longer (shorter) Compton wavelength ( $\Lambda_c$ ), and, consequently, to larger (smaller) angular momentum  $G_c = e^{A_c}$ , where  $\Lambda_c = \alpha_c^{-1}$ . Note that in the micro-realm the Compton wavelength of the electron is constant ( $\lambda_e = \frac{1}{2}\omega$ , where  $\omega$  is the angular momentum of the electron), so all cosmic spectra should be either red- or blue-shifted relative to this invariance, implying, respectively, either gravitational repulsion or gravitational attraction; accordingly, cosmic structures rotate differently relative to the fixed frame of reference linked to the angular momentum of the electron  $\omega$  which, it must be said, has its own handedness.

Now, we can state the obvious: in full accordance with Poincaré’s recurrence theorem (if entropy is increasing now, it will certainly decrease in the future) all material constituents of the universe are destined to die of old age. As earlier noted, an aging planet becomes more uniform, therefore it needs less entropy supply to stay in equilibrium, implying that  $\alpha_c$  tends to  $\alpha_w$ —once these quantities become equal, the last quantum of once-living matter disappears in void where a new star and a new life are to be born. Thus, the universe can be thought of as a

feedback information system in which cosmos and chaos constitute a complimentary ontic pair organized in such a way that gravity compensates entropic effects, which, in particular, allows sentient biological forms in certain spatial enclaves of the universe to emerge and exist for a time. Matter, however, is destructed and formed in a phoenix-like manner, while information is conservable: if it can no longer be linked to matter, it can only be linked to void (which, in particular, explains the black hole information loss paradox). Thus, mechanical destruction is restricted to within the radius of the void particle, so the spatial container of information can never be annihilated, which, physically, means that no refrigerator can reach absolute zero (null), accordingly, there always exists a possibility of information exchange between void particles: mathematically, this is relevant to a mutual correlation between the alpha and the omega variables—being irrational numbers, these variables can be combined infinitely often, thus providing a theoretical opportunity for an unending information exchange. If that process runs smoothly, then every consecutive decimal digit arising via that cosmic dialogue implies a new degree of freedom, leading to escape from darkness through a graceful exit to light—until that time, no information inside the void contour can be converted into light signals.

It is worth noting that the pattern described evokes a parallel with the holographic scenario claiming that all information required to describe the universe is encoded on a boundary of its equilibrium, from where it is emitted throughout the universe in the form of ordered quantum fluctuations, which, it must be remarked, is impossible without memory. If we assume that memory emerges as a result of change from the state of not knowing to the state of knowing arising via quantum interactions, then it is precisely accumulation of quantum information that results in quantum memory, and this memory is objectively prior to ordinary matter, which, in particular, implies that quantum correlations are prior to the physical medium known as the space-time continuum. The bright side of this ontic asymmetry is that the priority of quantum information over ordinary matter would be logically incomplete without its complementarity: the entire material world around us. Epistemologically, this connection is relevant to Wheeler’s “it from bit” hypothesis, assuming that anything physical, any “it”, ultimately derives its entire existence from discrete binary choices (bits). In principle, void can be viewed as an objectively existing physical substance having certain extension underlying ordinary matter; given such insight, we are able to claim that the inverse proposition (“bit from it”) is equally relevant to physical theory, which is the answer to the proverbial chicken-or-egg dilemma: void serves as a spatial container of information, while information serves to build the universe out of void.

## 11. Triple conjunction

Logically, the origin of the time-and-matter continuum traces back to the following relationship:  $S_0^{-1} = m_w = \alpha_w$ , where  $S_0 = \alpha_w^{-1}$  is the gravitational potential of the void particle. The crux of this logical inversion is that the fundamental information ( $m_w = \alpha_w$ ) has been *instantaneously* created without a bit of entropy increment—it is precisely the null-entropy limitation that played a crucial role in the origin of the time-and-matter continuum—void was irrevocably tethered to the gravitational potential of the void particle, implying ultimate *temporization* between gravity and matter, encapsulated in the following relationship:  $m_w = \alpha_w$ . Clearly, it is precisely this relationship that lies at the core of the equivalence principle, claiming that gravity and inertia are of a similar nature (in terms of the present research, this similarity is manifest in the following equation:  $F_w = \alpha_w G_w$ , where  $F_w$  stands for inertia and  $G_w$  for gravity). Given the dynamical nature of physical reality, it would be reasonable to talk about a *causal* link between inertial and gravitational masses rather than about their mutual equivalence, which means that gravity and inertia cannot be put on equal causal footing: inertial (translational) motion of material body arises from gravity (rotation), but not the other way round, and whenever one claims that masses of elementary particles *create* gravitational fields, this should not be understood in the sense that masses of elementary particles actually *cause* gravity, what this means is that any constituent of the universal quantum vortex, be it neutrino, electron, photon, proton... has a mass, which means that it is affected by gravity.

Thus, the transition from the pre-time universe to its existence in time occurred in a completely complementary manner: the newly emerged entity was given a full freedom of movement across the whole space of the universe, while the old state became the absolute frame of reference to which this freedom was ultimately tethered, thus making it possible to establish the most reasonable nexus between the primeval radiation and the nascent dynamics of the material universe. Here it would be appropriate to highlight the fundamental role of the alpha in mediating between radiation and matter via connecting the gravitational potential of the void particle, the radius of the universe, the quantum of action, and the angular momentum of the electron as follows:  $\alpha_w = \frac{\hbar w}{\omega} = \frac{F_w}{G_w}$ .

Properly organized, the void particles unwound in an exponentially  $\mp r_0$  –referential spiral fashion following a series of paths marked with spatially invariant local peaks arising via alternation of the left- and right-hand turns of the void particles. Thus, a series of these contra-rotations resulted in polarization of primordial void with its subsequent division into luminous and dark domains, and formation of ordinary matter arising from the fermion-like asymmetric separations that underlie symmetric boson-like higher-order correlations. Due to the asymmetry of the microscopic fermion-like fluctuations, the universe was no longer homogeneous, and as the quantum information exchange intensified the universe was becoming inhomogeneous, anisotropic and hotter. From this, in particular, it follows that the formation of ordinary matter was running from lower to higher temperatures via a series of recursive thermal relaxations, which, in particular, explains extraordinarily low temperature of the primordial radiation (the cosmic microwave background radiation). Next, the peaks of the universal quantum vortex were sequentially localized, which confirms the empirical evidence, showing that the absolute mechanical maximum corresponds to the iron peak in the periodic table (which is also a peak of thermonuclear reaction:  $H \rightarrow \dots \rightarrow Fe$ ; from the perspective of the loop-like *modus operandi* of gravity this reaction can be written as follows:  $H \dots \rightarrow C \leftarrow N \rightarrow O \dots \leftarrow Fe \rightarrow \dots \leftarrow Ag \rightarrow \dots \leftarrow Au \rightarrow \dots \leftarrow Tl$  ( $P(Tl_{208}) \approx 63.2\%$ )  $\leftarrow Bi \rightarrow Po$  ( $P(Po_{212}) \approx 36.8\%$ ) ..., where  $P(\text{element})$  is the probability of the element decay bracketed). According to our convention, formation of matter (assembly and rarefaction of void) is a strictly individuated process. Due to individuated values ascribed to every quantum of action, physical-and-chemical coupling-and-scattering are arranged in an invariant fashion, which, in particular, means that individually canalized quantum information is strictly related to the iron peak, and, accordingly, to other element abundances arising from the same *modus operandi* of gravity, which is manifest in appropriate individuated thermal measures for every chemical element or molecular entity (for example,  $0^\circ\text{C} \div 100^\circ\text{C}$  for water).

It is increasingly clear that the iron peak spatial invariance traces back to the double helix pattern described: this peak corresponds to the proton-neutron contacting layer ( $x \in [-e^{-1}, 0]$ , see Fig. 1), where neutron area implies a quantum coupling with undifferentiated void, and it is precisely this area that is marked with a huge gravitational steepness which is distinctly recognizable at the macro-scale (Table I). According to the model, this steepness corresponds to a maximum peak of mechanical pressure arising from the neutron influx, which is manifest in the maximum of entropy-gravity *asymmetry*, thus implying the least possibility for compensation of the mechanical pressure arising from undifferentiated void; as the model assumes, this peak of asymmetry is relevant to the iron peak associated with the maximum value of magnetic-mechanical momentum of the universal force (thus, the proton-electron positional relationship is relevant to asymmetry-symmetry parity correlated with magnetic-mechanical properties of atoms, as pointed out long ago by Pierre Curie). To complete this thought, the double helix pattern (Fig. 1) allows us to readdress the connection between the “electric field” and the “magnetic field”, which is manifest in their mutual orthogonality predefined by the appropriate relationship between the time-rate of the electron and the radius of the proton (Fig. 1). Logically, this positional interconnection is fundamental to the primordial polarization of void; physically, it makes sense to look at this phenomenon from the standpoint of Brewster’s law, stating that perfect polarization occurs only if reflected and refracted rays are set orthogonally to each other: accordingly, the perfect polarization of void should be expected at the angle corresponding to  $\cos \varphi_d = 10 \cdot T_{proton} \cdot \alpha_w = \frac{\Im(N_2)}{\text{mod}(N_2)}$  which is the primordial angular displacement ( $\varphi_d$ ) against the symmetry inherent in the attractor, encoded in the following relationship:  $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$ . To this, it may be added that the iron peaks are invariant under spatial rotations; in particular, for that very reason a compass needle is always directed along the route determined by differently scaled entropy-gravity equilibriums (the same rationale stands behind the random rotation of the needle at the magnetic poles which are boundary points of the entropy-gravity equilibrium of the Earth). Clearly enough, the cosmic radioactive process has been accompanied, and continues to be accompanied, by magnetic poles reversals, and, as earlier noted, the running value of the magnetic declination is amenable to consideration in terms of the electron-proton positional relationship (Fig. 1). Accordingly, the iron peak spatial invariance explains the existence of a shift between geographic and magnetic poles of the planet, which strongly supports Taylor’s and Wegener’s continental drift hypothesis, claiming that the continents of today drifted apart from a super-continent called Pangaea.

To complete the paper, if the objective of the present research were to reduce the conservation laws of physics to a single equation, it would be written as follows:  $0_w^0 = 1$ . Formulated in terms of the micro-scale, this equation becomes easily recognizable as zero-point energy conservation law:  $0 \cdot \ln 0_w = 0$ , given that energy is a measure of mutual attraction and repulsion of the opposites  $\pm r_0$ . Thus,  $\pm r_0$  can be thought of as representing a classical bit with two equally possible states, which implies an ultimately compressed message that lies at the heart

of a game in which the dice are thrown without a break, but what really matters is that for the universe as a whole it does not matter whether the outcome of the toss is heads or tails—the game is strictly governed by the law of information conservation: according to Wiener, the information carried by a message is the negative of its entropy, and the negative logarithm of its probability: the more probable the message, the less information it gives. The minimum information about the universe is zero ( $\mp r_0$ ), therefore the information coupled to the most probable message is defined as follows:  $-\ln 1 := \pm r_0$ , which is amenable to reason since both negative and positive probabilities are consistent with the concept of the ultimate reality; accordingly, the minus-plus sign implies that entropy increases as information degrades and, reciprocally, entropy decreases as information accumulates, which is manifest in the sign interchange between the maximum ( $R_w$ ) and the minimum ( $r_0$ ) information on the universe:  $\mp R_w = -W^{-1}(\pm r_0)$ , where  $r_0 = \frac{1}{|\sqrt{10}\omega|} \cdot 10^{-57} \approx 42 \cdot 10^{-59}$  (emphasis added). Speaking in more specific physical terms, the conservation law described is manifest in the following relationship between centrifugal and Coulomb forces:  $\frac{mV^2}{r} = \frac{e^2}{r^2}$ , appropriate substitutions (Table II) bring us immediately to the following interpretation of perpetual rotation:  $\frac{8}{\omega} = \frac{8}{\omega}$  which is tantamount to  $1 = 1$ , thus making it possible to appreciate, once again, a mathematical elegance with which the realm of physical knowledge is shaped.

## 12. Concluding remarks

The paper claims that it is precisely certain quantum information disguised as gravity prevents the physical world being presented as a purposeless motion of quantum objects: connecting the cosmological scale (implying the multiple degree of freedom,  $G_w$ ) with the quantum scale (implying the single degree of freedom,  $\omega$ ), gravity generates a long-range collective dynamical order via turning the universal quantum vortex into a coherent quantum system in which multiple degrees of freedom settle into a single degree of freedom. Physically, this mechanism offers no escape from determinism, but such physical determinism does not mean that humans' future is completely predefined—given that natural parallel, we are able to claim that survival of a distinct civilization depends on its ability to master degrees of freedom. Whether humans will succeed in this endeavour remains to be seen.

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