Testing gravity with equilibrium: an algebraic sketch of evolution

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Abstract: The radius of a void particle is proposed as a basic invariant scale of the universe; analytically defined, this invariant allows us to reveal: (i) an analytical relation describing the interaction of fundamental forces of nature on both quantum and cosmological scales; (ii) the analytical form and cosmological meaning of the fine structure constant; (iii) the origin of time, and the role of gravity as regards entropy dissipation. On the basis of the latter claim, it is argued that inevitable entropy growth does not necessarily result in ultimate chaos.

1. Introduction

Reflecting on how nature might be explored, under the assumption that it is organized according to principles amenable to reason, it was a physicist who remarked: "One may describe the situation by saying that the mathematician plays a game in which he himself invents the rules while the physicist plays a game in which the rules are provided by Nature, but as time goes on it becomes increasingly evident that the rules which the mathematician finds interesting are the same as those which Nature has chosen" [5]. The quotation perfectly encapsulates the central point of the paper, which is to show how pure algebraic research allows natural phenomena to be explored: the research to be presented yields a uniform numeric measure of matter, time, and space that allows the physical world to be described algebraically in terms of pure numbers united by common laws of relationship.

The paper explicitly and intentionally avoids addressing the pillars of current mathematical physics, such as probabilities as applied to quantum mechanics, or stress-tensors as applied to gravity exploration; as effective as these are in their domains of application, they are methodologically irrelevant to the central purpose of this research, which is to explore the initial and boundary conditions of the universe. Nevertheless, the research does not intend to challenge the meaning of basic concepts of physics such as causality, matter, space, time, or relativity—once regimented according to a logic that is considered to be favoured by nature, and endowed with a mathematical skeleton, these basic concepts fit perfectly together to reveal the original symmetry of nature, while also providing current cosmology with a complimentary ontological insight. Seeking as it does to address the physical foundations of evolution, the research deliberately avoids venturing into the deeper waters of current physical knowledge—these two approaches are too conceptually dissimilar to each other to be incorporated into a common interdisciplinary elaborative scientific framework, at least for now.

2. Structure of the paper

The structure of the paper can be given in terms of the conclusions as they appear in the text. (i) Fundamental physical forces are related to each other through a special state of the universe, namely the state of thermodynamic equilibrium; the singularity inherent in this special state makes it possible to deduce an analytical relation describing the interaction of fundamental physical forces as well as an analytical relation connecting the micro- and macro-states of the universe. (ii) Elementary particles form a dual, hierarchically organized, multi-scaled, and symmetrically inverted entity; differently scaled objects of this entity are algebraically interconnected via the fine structure constant; this constant is analytically defined in terms of the Lambert function. (iii) Gravity is considered as quantum information underlying the time-space order, and as connecting quantum and cosmological scales of the universe through a feedback loop; and in conclusion, the paper discusses the relevance of this loop for the understanding of evolution in general.

3. Equation of equilibrium

One of the purposes of this paper is to explain how the universe, governed by particular initial conditions, proceeds to thermodynamic equilibrium, reaches this state, and shifts into reverse away from this state. An analytical relation connecting the fundamental physical forces at the point of equilibrium can be deduced from the formulae of current physics, and written as follows (see [1] for the logic underpinning the reasoning, and [2] for the technical details of the deduction):

$$(x) \cdot \left(e^{x^{-1}}\right) \cdot \left(x \cdot e^{x^{-1}}\right) = x^2 \cdot e^{2x^{-1}} = T \cdot G \cdot F = \Omega \tag{1}$$

$x = \alpha_w$ is considered to be the absolute constant of time, or the absolute constant of nuclear forces (T), or the time-rate of the electron at the point of equilibrium; this numeric value ($\alpha_w \approx 7.29739 \ldots \cdot 10^{-3}$) is very close to the currently accepted value of the fine structure constant ($\alpha \approx 7.29735 \ldots \cdot 10^{-3}$).

$G = e^{x^{-1}}$ is considered to be the absolute constant of gravity $\approx 3.263 \ldots \cdot 10^{59}$.

$F = x \cdot e^{x^{-1}}$ is considered to be the absolute constant of electric force, or the radius of the universe at the point of equilibrium $\approx 2.381 \ldots \cdot 10^{57}$.

$\Omega = x^2 \cdot e^{2x^{-1}} = 10 \cdot \omega \cdot 10^{114}$ is considered to be the absolute time of the universe, that is, the pathway of the universe from its initial state to the point of equilibrium considered in terms of duration.

$\omega = W(1) \approx 0.567 \ldots$ is the omega-constant; W is the Lambert function defined implicitly as $z = W(z) \cdot e^{W(z)}$, where $W(z)$ is the Lambert function of a complex number z.

The absolute constants describe the universe as a holistic macroscopic object, i.e., as absolute macro-state; its micro-states are described in terms of elementary scale. The elementary units of time, mass, and length are defined as follows: $t_w = ln^{-1}\Omega$, $m_w = ln^{-1}G$, $l_w = ln^{-1}F$, respectively. In what follows, upper-case letters denote the absolute scale while lower-case ones denote the elementary scale; since α_w—according to our convention—relates to the elementary object known as the electron, it is reasonable to link the elementary scale with this elementary particle. Thus, the unit of length is defined as the elementary measure of the radius of the universe corresponding to the point of equilibrium; the unit of mass is defined as the elementary

measure of gravity corresponding to the point of equilibrium; and the unit of time is defined as the elementary measure of the absolute time of the universe.

It is worth noting that the absolute constants and their elementary derivatives are universal by definition: they are same for all times and for all observers in the universe; they do not depend on relative positions or speeds of the observers; and, most importantly, they are dimensionless in the sense of their being *number*—which defines the most fundamental level of existence and provides the most general analysis of any system irrespective of its particular elements, the forces involved, and the nature of their interconnections. The attentive reader will probably have already noticed that, in terms of algebra, the time-rate and mass of the electron at the point of equilibrium are indistinguishable ($\alpha_w = m_w$), thus presenting two physically meaningful equivalents. It is exactly this algebraic condition that allows us to deduce the analytical relation between the time-rates and masses of elementary particles forming time-space, as briefly discussed below.

4. Equation of time-Space

It should be stressed that the research underlying this paper assumes that the evolution of the universe is similar to the evolution of a human, and it is exactly this ontological assumption, supported by algebraic insight, that allows us to reveal the original symmetry of nature and deduce the appropriate conservation laws. Constrained by length, the paper attempts to explain the reasoning underlying the physical conclusions as compactly as possible; those interested in the details of the argument and the general ontological background of the research are encouraged to consult [1].

Purely algebraically, the relation between two values (say, omega and alpha) can be formally written as follows: $\frac{\alpha_w \cdot \omega}{\alpha_w} = \omega = \frac{\alpha_w \cdot \omega}{\alpha_w}$. One who sees *perfect* symmetry between the numbers ω and e ($\omega \cdot \omega^{-1} = e^{\omega} \cdot e^{-\omega} = 1 = \omega \cdot e^{\omega} = ... \omega^n \cdot e^{n\omega}$, where n is an integer) can express the parity of the time-rate and the mass of the electron at the point of equilibrium as follows:

$$\frac{\hbar}{\alpha_w} \cdot e^{\frac{\hbar}{m_w}} = 1 = \frac{\hbar}{m_w} \cdot e^{\frac{\hbar}{\alpha_w}}$$

(2)

where α_w is the time-rate and m_w the mass of the electron as defined above; the mid-part of Eq. 2, as shown in [2], *exactly* equals the radius of the electron at the absolute scale (R_e), and corresponding to the point of equilibrium, i.e., in terms of the Lambert function, $R_e = W(e) = 1$; $\hbar = \alpha_w \cdot \omega$ is considered as the elementary 'quantum of action' at the point of equilibrium (see [2] for the reasoning and technical details of this deduction). In terms of current physics, this value may be associated with the dimensionless analog of the reduced Plank's constant (in what follows, only the reduced forms of physical values will be used). It is worth noting that, as against Plank's constant, the elementary 'quantum of action' introduced here provides the possibility of a quantization of time-space, that is, the elementary 'quantum of action' allows the number of 'quantized particles' to be related to the point of equilibrium as follows: $N_{q-eq.} = F/\hbar = G/\omega \approx 5.75 ... \cdot 10^{59}$.

The principle of analogy—perhaps the most powerful tool of system analysis—allows us to extend Eq. 2 into the field of other elementary particles, so from Eq. 2 it follows that the time-rate and mass of any elementary particle univocally define its radius, that is, the space-like

outcome of the time–matter coupling. Based on analogical reasoning, Eq. 2 can be rewritten as follows:

$$\frac{\hbar}{T_p} \cdot e^{\frac{\hbar}{m_p}} = R_p = \frac{\hbar}{m_p} \cdot e^{\frac{\hbar}{T_p}} \tag{3}$$

where T_p, m_p, and R_p are, respectively, the time-rate, mass, and radius of a given elementary particle (p); $\hbar$ is the elementary 'quantum of action' of the electron as defined previously. Eq. 3 defines the algebraic condition of the spatial integrity of the universe: in such a way, the time-rates and masses of the elementary particles couple with each other, forming and conserving what is regarded as time-space.

5. Twin-realms

It is possible to calculate the time-rates and radii corresponding to the unique masses of separate elementary particles by substitution into Eq. 3 of appropriate values given in units of electron-masses; each unique mass has two roots, so, in algebraic terms, each elementary particle can be described as a twin-like entity having two time-rates and two radii. Table 1 shows how these two twin-realms are connected—via the electron-bridge. In the physics literature a gateway that connects regular matter and pure radiation is often referred to as a throat of a wormhole, or the Einstein-Rosen bridge; other readers may be tempted to understand it via the writings of Charles Dodgson (better known as Lewis Carroll), someone who was doubtless familiar with the notion of multiply connected spaces, wherein this 'bridge' is described as a door to a mirrored realm, first opened by a key found at Folly Bridge in the Oxford countryside, more than a century ago.

Table 1. Time-rates (T) and radii (R) of four selected elementary particles (R_e and r_e are electron radii at the absolute and elementary scales, respectively).

Particle	T	R	$T_{inverted}$	$R_{inverted}$
…			…	…
Twin-proton			≈ 0.00039	≈ 10.43
Twin-pion			≈ 0.00049	≈ 8.59
Twin-gamma-quantum			≈ 0.00055	≈ 7.67
Electron (e) and its twin	$= \alpha_w$	$= 1$ (R_e)	≈ 0.00257	≈ 2.84
Gamma-quantum (γ)	≈ 1	≈ 0.00414 ($2r_e$)		
Pion (π^+)	≈ 2	≈ 0.00207 (r_e)		
Proton (p^+)	≈ 13.3	≈ 0.000309		
…	…	…		

Table 1 enables us to imagine time-space as an entity arranged in the manner of a lock-in-a-key, in which a variety of waves resonate at particular time-space locales unequivocally defined by their time-rates and the corresponding radii where the wave manifests itself as a particle (in principle, this explains the phenomenon known as the wave-corpuscular duality of elementary particles). Looking at Table 1, a physicist cannot fail to see that the four selected particles define ranges of action of three physical forces, that is electric, strong, and weak, making it clear that

fundamental physical interactions present differently scaled manifestations of one universal force.

Equation 3 describes a dual hierarchy of wave-particles forming a multilayered symmetrically inverted pattern organized in such a way that each wave-particle has an appropriate twin in the inverted realm. In one realm the time-rates increase as radii decrease, while in the other realm the time-rates decrease as radii increase, so, theoretically, an action in the one realm should induce an appropriate counter-action in the twin-realm—notably, this fits Prigogine's idea of the reconciliation of entropy with the second law of thermodynamics: entropy may increase locally so long as the entropy of the external whole of which it is a part suffers a net decrease (see, also, [12]). Thus, the two realms can unceasingly induce each other, providing for the long-standing existence of the time-space continuum oscillating near the common centre of symmetry defined by the point of equilibrium; as follows from Eq. 3, this is exactly the radius of the electron that, first, serves as a centre of attraction of the universal force, secondly, bridges the differently organized twin-realms, and, thirdly, allows events occurring in the universe to be synchronized in inverse exponential proportion to the remoteness between them.

Yet it has been clear from the earliest times that the cosmos is connected with the Earth and, accordingly, this connection must have relevance as regards earthly knowledge. Step by step, physics has explored the quantum realm (left lower part of Table 1), while the symmetrically inverted twin-realm remains a dark side of the universe amenable only to rough approximations—and it is exactly here that algebra, literally meaning 'restoring' and 'forcing', bears the potential to explain how the quantum and cosmic scales of the universe are interlinked. The two realms, differentiated by time-rate, also have different time-scales and are marked by different passages of time, leading to essential differences in physicochemical process reaction rates: one cannot fail to see these differences as regards biological or geochemical processes occurring on the Earth; and cosmology also gives us an empirically proven example of time contraction, since events at a high redshift last longer than events at low redshift.

As viewed from this end of the universe, the other realm is nothing but the Carroll's universe that combines absolute space with relative time (this type of universe is introduced, and named after Carroll, by Jean-Marc Lévy-Leblond). It is clear that, as contrasted to the Carroll's universe, this mirror realm combines absoluteness of time with relativeness of space. It may be appropriate to note that the concept of twin-realms synchronizes well with both Newton's and Einstein's ideas of time: a gigantic world-clock ticks in accord with the laws of motion in a precisely predictable way while also it beats at different rates throughout the universe (this clearly resembles the old idea of time known at least to the ancient Egyptians, who considered time to be a dual entity: straight *djet* endures in the cosmos while *neheh* pulsates on the Earth, but only a well-thought-out coupling of this pair shapes the world). Nevertheless, the concept of twin-realms takes us beyond both Newton's and Einstein's universes: in the former, time and space are absolute, and free will is an outright impossibility; in the latter, both time and space are relative, and free will is not an issue to be taken into account.

Symmetry underlying Eq. 3 allows us to define dimensional values corresponding to these radii. From an operational point of view, the product of T and R presents a *coupling constant* connecting mutually inverted twin-objects. In the case of the electron this value equals its time-rate: $T_e \cdot R_e = \alpha_w = R_{e-inverted} \cdot T_{e-inverted}$. In principle, if the dimensional Compton

wavelength of an elementary particle is known, one can calculate dimensional radius-equivalent for the appropriate elementary particle as follows: $r_{p-dimensional} = \lambda_p \cdot T_p \cdot R_p$, where the right-hand terms are, respectively, the dimensional elementary Compton wavelength, time-rate, and radius of a given elementary particle p at the absolute scale. For example, drawing on the data presented in Table 1 and the physical values obtained through empirical research [8], one can calculate the radius-equivalents, for example, for proton $\approx \frac{0.841...}{1000}$ fm, pion $\approx \frac{0.585...}{100}$ fm, or electron $\approx \frac{2.818...}{1}$ fm... anyone capable of multiplying can continue making up this set. Taking into account the roughness of the approximation specific to exponential operations of high orders of magnitude, and the slight difference (accurate to the ninth decimal place) between α and α_w, these results appear to be relevant to the empirical data; of course, the scale coefficient of the universe—*a factor of ten*—should be taken into account.

6. From void to electron

Equations 1–3 describe the universe at the point of equilibrium, that is, in the state of its complete coincidence with itself; this state can normally be reached through identity transformations: in terms of algebra, this corresponds to the process of self-similarity. Self-similarity of a unique specimen (say, F) can be formally written as follows: $F^{-1} \cdot F = 1$, where F is the radius of the universe at the absolute scale, or the absolute 'quantum of action' (H) characterizing the full strength of the universal force at the point of equilibrium; its inverse value (F^{-1}) presents the smallest physically possible measure of time-space equaling $(\sqrt{10\omega})^{-1} \cdot 10^{-57}$ (approximately, $0.42... \cdot 10^{-57}$). In what follows, this value will be referred to as the radius of the void particle. It is considered that the radius of the void particle represents the primordial knowledge about the universe: wavelength as a spatial primordial symmetry, and frequency as a temporal primordial asymmetry. Furthermore, current physical knowledge allows us to describe the transition from the void particle to the point of equilibrium in terms of the physical characteristics of the electron at both scales of the universe (Table 2).

Table 2. Selected characteristics of the electron as compared to the void particle as deduced from formulae of current physics [2].

Characteristic	Pre-universe	Absolute scale	Elementary scale	Source formula
Classical radius	F^{-1}	1	½ $\hbar$	$r = \lambda\alpha$
Quantum of action	Non-identified	$H=F$	$\hbar = \alpha_w \cdot \omega$	$\hbar = e^2/\alpha v$
Gravitational radius	$2F^{-1}$	½ F	½ $\hbar$	$R_g = 2Gm/v^2$
Compton wavelength	Non-identified	α_w^{-1}	½ ω	$\lambda = \hbar/mv$
Electric charge	Non-identified	$\pm\sqrt{\Omega\alpha_w}$	$\pm\sqrt{2\alpha_w^2\omega}$	See [2]
Orbital mechanical momentum	Non-identified	G	ω	$M_B = mvR_{Bohr}$
Intrinsic mechanical momentum	Non-identified	$\alpha_w^2 G$	$\alpha_w^2 \omega$	$M_i = mvr$
Ratio 1: intrinsic momentum to quantum of action	Non-identified	α_w	α_w	

Ratio 2: quantum of action to orbital momentum	Non-identified	α_w	α_w	
Ratio 3: classical radius to Compton wavelength	Non-identified	α_w	α_w	
Ratio 4: intrinsic to orbital momentum	Non-identified	α_w^2	α_w^2	

A glance at Table 2 reveals a parallel with the failed Einstein-Rosen idea of relating the electron to some initial unknown state of the universe: compare, for instance, appropriate gravitational radii $2F^{-1}$ and ½ F; now, take a look at the lower part of the table: four basic ratios are brought to the table to stress the outstanding role of alpha as regards the dynamics of the cosmological transformation of the universe and its role in connecting absolute and elementary 'quanta of action': $F/G = \alpha_w = \hbar/\omega$. Now we have sufficient grounds to assume (as was assumed in [2]) that the dynamics of fundamental physical forces is based on the following ratio: the 'speed' of the electron (in the first orbit of the hydrogen atom in Bohr's model) to the speed of group movement of electrons (light speed); if this ratio approaches the central attractor of the universe—the radius of the electron—as closely as an appropriately scaled radius of the void particle permits then strong forces act (they conserve the atom's integrity, and compensate gain in gravity), otherwise weak forces act (they stimulate nuclear decay, and gain in gravity). Obviously, once accepted as a guess, albeit one which is attended by a certain logic, this assumption must be supported algebraically: if nature is organized according to rational principles then the fundamental physical forces should act in accordance with some pattern, which this paper assumes comes through the point of equilibrium. As follows from Table 1, four remarkable elementary particles define three different ranges of action of the universal force, namely, the time-rates and corresponding radii for (i) electric forces acting within the e and γ-layers (α_w, 1 and 1, $2r_e$); (ii) strong forces acting within the γ and π^+ layers (1, 2 and $2r_e$, r_e); and (iii) weak forces acting beyond the Yukawa potential restricted by the π^+ and p^+ layers, where the latter ultimately closes the gravity loop of the universe by connecting the radius of the proton and the radius of the void particle:

$$R_{proton} \approx \alpha_w \cdot F^{-1} \cdot 10^{56} \approx G^{-1} \cdot 10^{56} \qquad (4)$$

This equation explains, in particular, why all the objects of the universe choose a preferential—clockwise—symmetry in the earthly world: this is caused by the predominance of the motion of elementary particles in one direction—towards the void particle connected with the proton via the electron (and exactly for this reason there should exist counter-wise preference symmetry as applied to the twin-realm: astrophysical observation shows such phenomenon in the direction of the north pole of the Milky Way). As earlier explained, it is exactly the radius of the electron that conducts itself as a central attractor of the quantum realm; accordingly, there should exist a twin-attractor on a cosmological scale (and astrophysical observations confirm the existence of such an object on the other side of the Milky Way). The pattern of the gravity loop aids our understanding of why the Earth obtains electromagnetic radiation from the Sun mostly through one range (visible near-infrared) while it radiates the same radiation mostly through another range (the far-infrared part); it should also be noted that the pattern is in excellent accord with the physical experiments of Henri Bénard (see, for example, [13]). Due to instabilities permanently occurring in physical reality it takes time to generate the feedback loop signal; and

meanwhile, an elementary quantum object is free to shift, rotate, compress, and tend towards to scattering. As regards empirical reality, this quantum uncertainty leads to time-symmetry violations observed in the weak interactions, and this should not come as surprise—this layer is the weakest link of the gravity loop as compared to strict determinism inherent in the electric and strong force layers (see Table 1). As will be shown below, the quantum uncertainty arises as a result of the action of the initial selection mechanism that strictly determines the borders of this uncertainty.

7. Meaning of gravity

According to our analysis, wave-particles pass through multilayered time-space due to the differences in their time-rates, and exactly these differences produce the effect of extra-long-range action generally accepted in physics as gravity—acting like ordinary mechanical pulleys, these invisible layers form a 'silent structure' that only transmits motion without producing it; therefore, the strength of the void particle, which is considered as a basic scale invariance underlying all natural transformations, grows not once but over and over via each layer. This interpretation means that gravity is quantum information that ensures objectively real physical process of motion. Naturally, in the sense of being information gravity is a physically unobservable phenomenon, and thus cannot be recognized alongside the mechanical forces (this research allows us to assume that gravity can be based on ultra-fine quantum fluctuations but unless they are not detected it would be reasonable to associate gravity with 'quantum information'); therefore, the absolute constant of gravity only foreshadows the amount of information on all possible ways of coupling between the time-rates and radii of wave-particles at the point of equilibrium (in terms of thermodynamics, this information is defined as a number of micro-states, which the elementary particles can occupy provided that all the micro-states belong to the same macro-state, that is, to the universe at the point of equilibrium). Then, mass can be defined as a measure of actualized gravity (paradoxically or not, this definition is consistent with Newton's concept of gravity according to which an invisible force called 'gravity' is an inherent property of matter and is directly proportional to an object's mass). It is exactly gravity that prevents the physical world being presented as a purposeless motion of particles—the concept of thermodynamic equilibrium as a state of maximum disorder is true only in a gravity-free environment, and the commonly held view that entropy is a measure of disorder is meaningless unless gravity is taken into consideration. Thus, gravity determines the manner of interaction of wave-particles, forming of their collisions an apparently purposeful motion, and generating what is commonly accepted as time-space—the end result of the interaction of the elementary masses originating from gravity.

8. Equation of evolution

Without doubt, information in general, and particularly algebra as describing relations between informational objects, refers to a more fundamental level of reality than physics—whether quantum mechanics describing the behavior of elementary particles, or relativistic concepts exploring space-time kinematics as a whole. Today, relativity is the mainstream view within natural science. It provides for a fair amount of accuracy as regards locales such as near-earth space where the curvature is relatively small, but becomes invalid at the scale of the whole universe. The reason for this is well known: the point of origin of the universe in such a frame is not identified, so the initial and boundary conditions are unknown, and therefore a single-valued solution to the general relativity field equations does not exist—

this is *a fact* of algebra, so, mathematically speaking, any attempt to string the concepts of relativity together with quantum mechanics is doomed to failure until initial and boundary conditions compatible with the laws of nature are identified.

Clearly realizing this natural demand, field theorists have sought to manage it through the cosmological constant—the inverse square of 'world radius'—invented to compensate gravity (see, for example, [18]). In terms of the algebraic model presented, this is inverse 'Big Omega' (Ω^{-1}). Inversed and reduced to the elementary scale, 'Big Omega' equals the elementary unit of time, reversed in sign ($-t$). Certainly this does not mean that time may flow backward: it neither flows nor runs—it merely allows rates of change of dynamical processes to be measured, and in particular the negative sign of elementary unit of time allows these processes to be measured as regards the two fundamental counter-states of the universe (one corresponds to the void particle (Ω^{-1}) while the other corresponds to the point of equilibrium (Ω)). In terms of algebra, there is no difficulty in connecting these states:

$$ln\Omega^{-1} = -ln\Omega \tag{5}$$

This Janus-like equation describes the basic relation between the two unique endpoints of the universe: its unique microscopic state and its unique macroscopic state. One cannot fail to see that these states manifest global symmetry of the universe, that is, space–time invariance. However Eq. 5 is mostly remarkable for its idea of zero, that is, $0 = ln\Omega^{-1} + ln\Omega$ means that sum of net potential of a particular system and perfect actualization of this potential equals zero; in terms of the evolution of the universe, this means that the radius of the void particle defines the only possible upper bound of the universal force, that is, the limit of its physical freedom, which manifests itself at the point of equilibrium; in terms of entropy–gravity relations, this limit of freedom defines the absolute force, or the radius of the universe at the point of equilibrium as a ratio between the absolute constant of gravity and the free initial entropy of the void particle, that is, $G/\alpha_w^{-1} = F$ (free initial entropy of the void particle is defined in Section 9). In terms of ontology, Eq. 5 raises a question of how two categories are interconnected: being and becoming; as viewed from the perspective of ontology, the sum of being and its culmination cannot equal zero—this 'zero' should comprise at least the minimum information needed to create a universe; this does not allow *ex nihilo* concepts to exist, at least as regards the physical hypothesis of origin of the universe (but it does allow Achilles to catch up and surpass the tortoise). Clearly, the interpretation of zero given by Eq. 5 is a mathematical idealization arising from the algebraic fact that the logarithm is a monotonic function of its argument but, actually, 'zero' is inconsistent with both ontology and physical reality: as Einstein noted, in so far as the laws of mathematics refer to reality, they are not certain; and in so as far as they are certain, they do not refer to reality. Ultimately, it is physics that is about reality while mathematics is about possibilities, and this idealized concept of zero works perfectly to explore new ones.

9. Initial selection

Now we can turn, so to speak, to entropy (literally meaning 'in-turning' as contrary to evolution literally meaning 'un-rolling'; entropy, as shown below, feeds gravity, forcing evolution to unroll). Drawing upon Boltzmann's formula describing thermodynamic systems ($S = k \cdot lnW$), one can calculate: (i) the entropy of the universe at the point of equilibrium $S = G$ (in this case the universe is regarded as the absolute macro-object, and Boltzmann's constant (k) is considered to be an appropriately scaled 'quantum of action', i.e., H); and (ii) the

entropy of the electron at the point of equilibrium $s = \omega$ (in this case the electron is regarded as a micro-object, and, appropriately scaled, Boltzmann's constant (k) takes a value of an elementary 'quantum of action', i.e., $\hbar$); in both cases $W = G$. Note that the calculations of entropies account for both micro- and macro-states of the system, and therefore it should not come as a surprise that the ratio of macro- to micro-entropies exactly equals the number of 'quantized particles' of the universe at the point of equilibrium, as shown earlier in this paper (Section 4).

Let us now take a closer look at the orbital mechanical momentum of the electron (Table 2), and see how algebra connects quantum, gravity, and entropy: the values of this momentum are G and ω at the absolute and the elementary scales, respectively. Furthermore, the ratio connecting macro- and micro-entropy in terms of the logarithm function ($ln(S/s) = \alpha_w^{-1} + \omega$) can be expressed in terms of quantum mechanics as well, namely via the Compton wavelength of the electron (Table 2) as follows:

$$ln(S/s) = \Lambda + 2\lambda \tag{6}$$

where Λ and λ are the dimensionless Compton wavelengths of the electron at the absolute and elementary scales, respectively. Although there is a remarkable amount of confusion about the meaning of entropy, modern sciences consistently distinguish at least two of its aspects: thermodynamic and informational; this paper considers the former as an external manifestation of the latter. As follows from the equation of equilibrium (Eq. 1), external (electro-mechanical) changes occur slower than the accumulation of information, and therefore the gravity range that establishes casual relations exceeds the range of action of the electric force (even within the frame of the solar system the strength of gravity exceeds the strength of electromagnetic interactions, and needless to say the same goes on the larger scales of the universe). This illustrates the principle of causality interpreted in terms of this paper as follows: cause (gravity-information) goes ahead of effect (actions caused by the universal force). That is why gravity is considered to be the first force that split off from the other three forces in the course of the 'grand break' of a primordial symmetry, and it is exactly gravity that forms the feedback loop aimed to hold all the fundamental forces together in an entropy-dependent volatile environment.

Next, we show that by using Boltzmann's formula one can calculate the entropy of the void particle: $S_{prim} = \alpha_w^{-1}$ (assuming $k = 1$, that is, a void particle produces no electro-mechanical actions); this is the absolutely unbounded force of void, that is, free entropy; the difference between the final and initial entropies of appropriate micro-objects ($\omega - \alpha_w^{-1}$) can be considered as 'negative entropy'.

Now, physical formalism requires us to connect the free entropy with the point of equilibrium in terms of thermodynamics, that is, to define the absolute temperature of the universe corresponding to the point of equilibrium. However, this does not appear as a trivial task, and what is suggested below should be regarded as a least-bad solution: reinterpreting Teller [14], we could define the absolute temperature as $T° = \frac{G \cdot M}{F} = \alpha_w^{-1}$ where G is the absolute constant of gravity, F the radius of the universe at the point of equilibrium, and $M = 1$ the mass of the universe at the point of equilibrium—it is assumed that all the mass of the universe at this point is gravitational, that is, not regular mass but pure radiation.

Next, we approach one of the most esoteric aspects of the evolutionary paradigm, that is, the initial twist of the scalar mode of the universe; literally meaning 'ladder', this mode provides

the initial selection and fine-tuning of prospective physical constants. Of course, this is pure intuition, supported by algebraic insight, that allows us to describe the origin of the scalar pattern in terms of *discontinuous* recursive transformations as follows:

$$-x^{-1} \quad \mapsto W(-x^{-1}) = -1 \mapsto W(-1) \mapsto a\text{–} point \ (\rho \approx 137 \cdot 10^{-2} \ and \ \varphi \approx 103°)$$
$$\updownarrow \tag{7}$$
$$x \quad \mapsto W(x) = 1 \mapsto W(1) = \omega \mapsto \omega\text{–} point \ (1 + \ \omega i)$$

where $x = e$ is Napier's constant; different equivalent forms that describe final points of both branches of the expression—polar coordinates and complex plane—are used for clearer presentation. The upper branch of this pattern defines the time-rates of the prospective proton and electron, and thus can be regarded as the alpha- or time-branch of evolution, while the lower branch may be referred to as the omega- or matter-branch since it leads, as will be immediately clear, to the radius of the prospective proton. Thus, we come to the initial twist of the scalar mode of the universe—the double helix pattern that allows us to see how gravity starts to produce order out of the surrounding chaotic motion of the void. It would be appropriate to present this pattern in terms of the complex plane:

Figure 1. The initial twist of the double helix pattern.
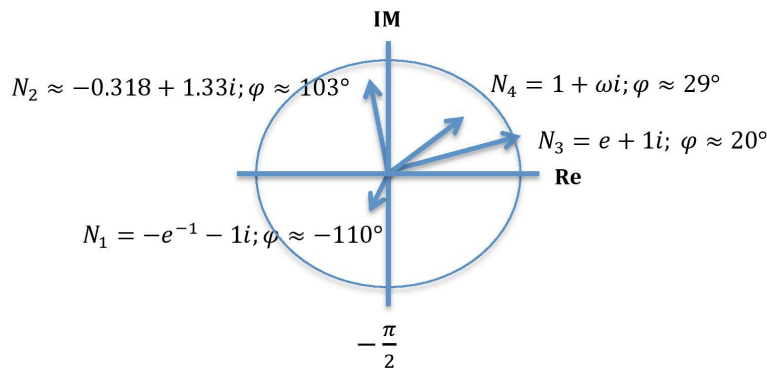
Multiplying the extreme numbers of the pattern we come to the radius of the proton scaled in accordance with a factor of ten ($\approx \pi^2$), that is, $N_1 \cdot N_3 = (-e^{-1} - 1i) \cdot (e + 1i) = -(e^{-1} + e)i$, or $\rho \approx 3.09 \ ... \approx R_{proton} \cdot 10^4$; $\varphi = -\frac{\pi}{2}$. As we see, the pattern defines the time-rates and radii of the prospective proton as well as the time-rate of the prospective electron; these values are scaled in accordance with the scaling factor of the universe, namely, the appropriately scaled radius of the proton, as defined above, and the time-rate of the prospective proton and inverse time-rate of the prospective electron (the imaginary part and the polar radius of the second term of the pattern, that is, $T_{proton} \cdot 10^{-1}$ and $\alpha_w^{-1} \cdot 10^{-2}$, respectively).

Clearly, the initial twist of the double helix pattern describes the origin of the 'inflammable air'—as the medieval alchemists called hydrogen—and this explains the predominance of this element in the universe: this is the first shape drawn from the surrounding chaos. If void particles oscillate for a sufficient length of time they may make a graceful exit to a state of equilibrium, though this is not always for certain. As might be expected, the double helix pattern defines the boundaries of the basic uncertainty of nature—a path between the time-rate and the radius of the prospective proton, the weakest link that determines the vulnerability of the

entire prospective gravity loop (in terms of angles, this path exactly equals π). It is worth remarking that this property of self-organizing systems has been already detected as applied to dissipative structures: "Only initial conditions that go to equilibrium in the *future* are retained…", while "the initial distribution prohibited by the second law would have an infinite information content. That is the reason why we can neither realize them nor find them in nature" [9, pp. 276, 278]. Fitted to select oscillations leading to the equilibrium of the universe, the double helix pattern serves as an absolutely reliable barrier—only oscillations with suitable frequencies can pass this non-reversible trap, and make a pair with the prospective proton radius (expectedly, this 'suitable' frequency should correspond to the initial free entropy of the void particle or, equivalently, to the Compton wavelength of the electron at the point of equilibrium (α_w^{-1})). In its turn, the proton pair allows the primordial causality (gravity goes before force) to be reproduced in terms of time, namely, the time-rate of the prospective proton (time) goes before the radius of the prospective proton (space). Only when the point of equilibrium is reached does this irreversible motion of oscillations trapped by gravity become incorporated into a reversible pattern of a gravity-bound universe, forcing these oscillations to return to the neighborhood corresponding to the initial conditions defined by the radius of the void particle, as Eq. 4 describes. Clearly, the pattern is designed to select only the oscillations that satisfy the second law of thermodynamics; bit by bit information about the universe increases while the free entropy decreases, and when the free entropy of the void particle is completely exhausted, the universe will face its 'heat death' caused by this very second law.

This pattern—order through uncertainty—would not be viable if it were not framed by a strictly determinate relation with that through which the time-rate of the prospective electron is generated (see the upper branch of the double helix pattern; also, considered in terms of the electron, the basic natural uncertainty can be conventionally set as equal to 2π). As repeatedly explained in this paper, this is exactly the time-rate of the electron that serves as the central frequency attractor for oscillators of wave-particles tending *with time* to common frequency, though their individual frequencies may be different (see, for example, the Kuramoto model of collective synchronization). To all appearance, it is exactly this combination of strict certainty with the limited uncertainty underlying all transformations in nature that ensures the feeling of intellectual security so deeply rooted in human consciousness.

Thus, the double helix pattern represents an ordering rule based on the intrinsic information of the void particle: one of the roots of the equation of equilibrium describes an analytical relation between α_w and the radius of the void particle (Eq. 9). Each number of this 'cosmic blueprint' (Paul Davies's term) is associated with a self-extracted physically meaningful finite amount of information predefined by the initial conditions, that is, by the radius of the void particle. The initial information satisfies classical binary code ($\uparrow, \downarrow$), that is, either $-x^{-1}$ or x thus presenting a 'quantum of information' ($\hbar_{inf}$) that combines minimum entropy production with maximum gravity-information potential; inversely coupled, this quantum of information can be neither algorithmically compressed nor physically decoupled (mathematically, $\hbar_{inf}$ is the amount of information needed to create time-space of radius $x \cdot e^{x^{-1}}$).

From an ontological point of view, the pattern reflects the metaphysical duality of evolution seeking to generate self-amplifying, scale-invariant ways of transforming chaos into self-replicative order; thus, information produced at lower levels is used to reach the higher level, and information that does not contribute to this process is to be discarded. Of course, one

cannot fail to notice the outstanding role of Napier's constant in the process of this transformation, as well as to see how the basic ontological feature of the pattern—the dichotomy of nature—is algebraically supported. And perhaps it is not clearly seen, but the connection outlined between the time-like and space-like basic components of the prospective elementary particles signify the amphibious nature of imaginary numbers connecting time and space (this is clearly seen through the Lambert's function: $\frac{2W(-\frac{\pi}{2})}{\pi} = i = \sqrt{W(-e^{-1})}$). Speaking in terms of algebraic metaphors, imaginary number reconciles the two extremes of nature: certainty of reversibility (π) and uncertainty of irreversibility (e).

Whatever relations between these extremes may turn out to have, mathematical formalism requires an elementary event (state of p-particle) to be defined. The research on time [1] describes such an event in terms of eight-dimensional (octonion) algebra (for in-depth analysis of this line of reasoning the reader is encouraged to consult [1]). Based on Hamilton's elegant formulation, and supported by ontological insight, the particular implementation described by Eq. 8 nevertheless calls for a careful critical eye: unless empirically proven, this remains an intuitive logical guess:

$$\Delta + Ti + Gj + Fk + \delta + t_p il + m_p jl + r_p kl = event_p \tag{8}$$

where Δ is a real number which characterizes the value and direction of displacement of the absolute object relative to the point of equilibrium of the universe;

T, G, F are real numbers corresponding to the absolute constants of nuclear forces, gravity, and electric force;

δ is a real number which characterizes the value and direction of displacement of the elementary object relative to the absolute object;

t_p, m_p, r_p are real numbers corresponding to the time-rate, mass, and radius of the elementary p-object;

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

$event_p$ is a real number characterizing the state of the elementary p-object.

In current physics the Hamiltonian-based formalism is widely applied to describe instantaneous relative particle states rather than to describe these states as a whole; Eq. 8 fills this 'void' through the absolute terms, which manifest the full potential of a gravity-bound universe inherent in the special state of thermodynamic equilibrium; it perhaps should be mentioned that these absolute terms correspond to the elements of the main diagonal in the quantum chromo-dynamics matrix—current quantum mechanics has to consider them as functionless. Complemented in this fundamental sense, the revised matrix allows every locale of time-space to be defined in terms of the entire universe. Be this function presented in matrix or in analytical form, it explains how the event provides relevant feedback to ensure the integrity of time-space: aiming to reduce the effects of chaotic instabilities, gravity (guided by the principle of causality) minimizes any instability by forcing 'time' (the time-rates of elementary particles), 'space' (radii of elementary particles), and 'matter' (masses of elementary particles) to couple according to the principles, widely known to current physics, of least time and of least action. And, just to note: current physics finds it difficult to explain the phenomenon of the faster-than-light speed with which the positions of observable particles are correlated—the relative

'positions' of 'particles' are univocally defined by the multilayered feedback mechanism connecting the void particle with the quantum realm through the electron-bridge.

10. Roots of equilibrium

Now, it would be reasonable to look at the roots of the equation of equilibrium (Eq. 1); solving this equation, one finds that all three roots of it depend on the omega-constant, and only on omega-constant:

$$x_{1,2} = -W^{-1}(\mp F^{-1}) \text{ and } x_3 = -W_{-1}^{-1}(-F^{-1}) \tag{9}$$

where $F = \sqrt{10 \cdot \omega} \cdot 10^{57}$, and W_{-1} is the bottom branch of the Lambert's function defined for $x \in [-e^{-1}, 0]$. The two roots ($x_{1,2} = \pm F$) correspond to the counter-poles of the universal force at the point of equilibrium (or amplitudes corresponding to opposing phases of some colossal spherical standing wave, as an adept of a wave-universe concept might assume). It appears that only gravity could create this perfectly symmetrical wave: as earlier noted, the range of gravity exceeds the range of action of the electric force (by approximately 137 times, or, exactly, $\alpha_w^{-1} = G/F$); therefore, gravity acts in advance, or so to speak from outside. This appears to be a point where the scientist [9, p. 283]) and the poet [3, p. 340] become one: both agree that the beauty and power of gravity comes from *without*, not from *within*. This property of gravity makes it possible to loop, and thus to 'reverse' the flow of electric force, which has never been observed to flow backwards. To be clear: the range of action of the electric or the universal force is restricted by the following *exact* limit $R_e = 1 = \alpha_w^{-1} \cdot \alpha_w$, this corresponds to situation when the Compton wavelength of the electron (α_w^{-1}) becomes equal to the free entropy of the void particle (α_w^{-1}); once this limit is reached the flow of the universal force, as described earlier in this paper, starts reverse gravity-initiated motion towards the void particle as Eq. 4 describes. It is worth remarking that this reverse motion evokes a parallel with Ritz's emission hypothesis (see, for example, [8]), but this hypothesis requires the reversibility of electrical processes, which Walther Ritz himself regarded as physically impossible—perhaps this is the only point of agreement between Ritz and Maxwell-Lorentz electrodynamics (based on different views, both approaches have in common a lack of a reference point for the universe, without which physicists are doomed to return to the never-ending story compactly worded by John Wheeler: matter tells space-time how to bend, space-time tells matter how to curve…).

The third root ($x_3 \approx 7.29739 \ldots \cdot 10^{-3}$) is interpreted in this paper as a numeric value having the same physical meaning as the fine structure constant, and corresponding to the point of equilibrium (α_w). An alert reader may have already noticed that the three roots, first, show the structure of the void particle, that is, two contra-directional radii, and an omnidirectional time-rate (frequency), and, secondly, the absolute constant of gravity stands apart from the two partner-constants 'rooted' in the omega-constant, algebraically stressing the physical and ontological otherness of gravity from mechanical—electric and nuclear—forces. It is worth noting that the very algebraic core of the Lambert's function is a step-by-step recursive approach to self-similarity: this becomes more evident if the function is written as a series of embedded logarithms (see, for example, [16]). Thus, algebra tells us that, first, the way to the point of equilibrium is a result of *gradual* accumulation of information regarded here as gravity, and, secondly, gravity in the sense of being information still changes as the universe expands, oscillating near the point of equilibrium as defined by the equation of time-space (Eq. 3).

Evidenced by the physical world around us, and resting on the numeric difference between α and α_w, one can draw the conclusion that the state of equilibrium was once disturbed, and it is exactly the double helix pattern designed to follow the second law of thermodynamics that allows this disturbance to occur. Astrophysical data shows that the curvature of the current universe is remarkably close to zero, and this is traditionally explained by the rapid expansion of the universe during the inflation period; the relatively slight difference between α and α_w testifies that the universe in its current state is slightly asymmetric as compared with the universe at the point of equilibrium; most probably the slight asymmetric lop-sidedness, which is observed on the very large cosmic scale, and is frequently referred to as the 'axis of evil', owes its origin to the dynamics caused by the twin-realm pattern. The above algebraically testifies that the evolution of the Earth-system is directed from the point of thermodynamic equilibrium (this phenomenon is adequately described in [7] through geochemical cycling considered in terms of the principle of maximum entropy production).

It is worth noting that the fine structure constant discovered by Arnold Sommerfeld is not a constant in the strict sense: this is an omega-dependent variable corresponding to the post-equilibrium current ratio of the time-rate of the electron to the speed of light. In particular, it means that Dirac's intuitive idea supposing variation of the strength of gravity over the lifetime of the universe can be also explained in terms of algebra and ontology. Also, it means that the redshift, which is commonly interpreted as an evidence of current *spatial* expansion of the universe, has a complementary physical sense—if radius of the universe increases then, according to the algebraic formalism of the equation of equilibrium (Eq. 1), the value associated with the fine structure constant decreases, therefore the spectrum-shift can be associated with the time-rate differences between higher- and lower-gravity parts of the universe. This algebraic conclusion resonates in the physics literature in a concept of a variable gravity universe (see [17]), that is, as gravity increases radiation transforms into regular matter, and, according to this research, elementary particle masses as well as radii shrink in a coherent manner. Furthermore, the algebraic formalism of Eq. 1 demands alternation of expansion-contraction cycles of the universe to be ultimately dependent on the numeric sequence of the omega-constant. To be clear: the equation of equilibrium states that the isotropic expansion of the universe is in the direction away from the point of equilibrium, and the rate of the expansion is proportional to α_w/α, where α_w is the absolute constant of time, and α is the current value of the fine structure constant. Nevertheless, this algebraic fact alone does not resolve what is perhaps the deepest riddle of cosmology, that is: What is the ultimate fate of the universe?

11. The fourth

From the above, it should be perfectly clear why material bodies do not lengthen or compress spontaneously, the stars do not fall down to earth, electrons do not fall on protons, and the whole universe does not break into pieces. Ultimately, it is the omega-constant—the core and single algebraic value of the void particle—that is responsible for holding together the elementary particles in atoms, and for the integrity of much more complex cosmic structures. Omega plays a principal role in synchronizing the fundamental interactions as well as in connecting the time-rate of the electron with its mass as follows $\hbar/T = \omega = \hbar/m$. One cannot fail to notice that the equation of equilibrium (Eq. 1) presents the ultimate form of synthesis that can ever be reached via the sequential recursion of its elements—the next step leads to infinite iterations, the creation-free option associated in philosophy with the loop of 'bad infinity', that

is, repetition of one and the same pattern, which feeds on already existing information thus causing a non-productive infinity which contradicts the logic of evolution: nature does not allow systems with infinite memory to exist. In terms of cybernetics, the equation of equilibrium presents a typical nesting scheme with feedback, and four parameters which are algebraically free to be mutually adjustable, thus ensuring the self-consistency of the entire construction. Omega, the first and the last element of this algebraic construction, perfectly wrapped into the physical fundamentals, presents the one and the only 'cornerstone', hidden under the edifice of the universe. As history tells us, the 'builders' of this world repeatedly reject this 'stone', failing to grasp its sense as formulated in the ancient formula of universal transmutation known as the 'Axiom of Maria', named after a famed alchemist. In our days, physicists questing for their 'holy grail' seek to bridge different areas of physical knowledge through a fourth law of thermodynamics that is supposed to be responsible for the self-organization of matter-energy—an honest attempt to connect dynamics and the conservation of the universe within the theoretical framework based on the concept of clock-time.

12. Origin of time

Conceptually speaking, any hypothesis which hopes to describe physical reality must also be able to explain the origin of time. Now, we have sufficient grounds to define time as an objective measure of real physical processes—a pathway passed through by the universe from its beginning (the primordial micro-cause, Ω^{-1}) to its physical macro-effect (Ω, the point of thermodynamic equilibrium). As described by Eq. 5, this pathway establishes both the physical and ontological equivalence of the primordial cause leading to its ultimate logical effect, that is, the 'heat death' of the universe. Naturally, this pathway is viewed as asymmetric, timeless, and irreversible, unless Ω^{-1} and Ω 'meet' each other through the gravity loop; once looped, a timeless universe becomes a gravity-bounded hierarchically organized reversible world of *informed* order—an entity that is formed in accordance with a certain ordering rule.

Current physical evidence shows that thermodynamic equilibrium of the universe was disturbed and transformed into curved time-space; as explained above, this exit from the state of equilibrium was a perfectly designed implementation of the 'miracle' of reoccurrence—void entrapped by gravity, enclosed in time, and embedded in space, came to light through a series of identity transformations resulting in the creation of the universe. However, as explained in this paper, the reservoir of the free entropy of the void particle is limited; fixing information in a record increases entropy, and information decreases entropy since these two phenomena are inseparable from each other. At the point of equilibrium gravity has entirely dissipated the reservoir of the free entropy (α_w^{-1}), making it physically impossible to fix new information. As often happens, God is in the detail. The detail of this 'miracle' is viewed as follows: the information content of the universe was radically increased without additional entropy supply—information emerged as a result of inverse substitution of already bound information, that is, the value of the free entropy of the void particle was split up into two new—physically meaningful and algebraically equivalent—values: the time-rate and the elementary mass of the electron (α_w). Speaking in terms of mathematical formalism, what could not be resolved within the frame of Gödel's incompleteness theorem has been resolved via an exit beyond this frame. It is possible to further generalize this statement into the field of cosmology. It is a conventional point of view—within 'no boundary conditions' cosmology, and considering the initial conditions of the universe as entirely symmetrical—that information can arise only through symmetry

breaking. The 'miracle' in question manifests just the reverse: the symmetry was broken due to information arising from the intrinsic structure of the void particle (here we should distinguish, of course, shallow symmetry of deterministic chaos and deep symmetry underlying the time-space dynamical order as Eq. 3 and Eq. 4 describe). In a sense, gravity has beaten entropy at its own game—the microscopic statistical *equivalence* inherent in the state of equilibrium was broken by informational *equivalence* resulting in a deep symmetry of dynamical order of time-space. Loosely speaking, the symmetry of the equilibrium was disturbed by a subtle quantum fluctuation, which allowed all G/ω micro-states of the universe to be distinguished, matter and radiation to be separated, and the twin-realm universe to come into being. As far as the conventional point of 'no boundary' cosmology is concerned, it is of course true that information emerges as a result of symmetry breaking, but this is true as regards non-equilibrium locales in the current expanding universe; considered as a whole, symmetry and symmetry breaking form a complementary relationship that allows the world to be explored in a manner which seems to be logically complete.

Thus, gravity-information disturbed the state of equilibrium in an entropy-disabled noiseless way, and yielded the *structural redundancy* that allowed each micro-state of time-space to be fully specified in terms of symmetry. Physically speaking, it was a moment when all elementary orbital momenta of new-born electrons (ω) excited a resonance which resulted in the absolute orbital momentum of a new-born universe (G); in terms of algebra, this resonance-peak can be formulated as follows: $e^{x^{-1}} = \Omega$, where $x = t_w$). In a sense, it was a sort of informational synergism that transformed the explicit meaning of alpha-constant as the free entropy of the void particle into a holistic triadic relation connecting bound and potential information through the omega-constant hidden in the radius of the void particle (as the 'Axiom of Maria' describes). Disturbance of equilibrium, symmetry breaking, and subsequent expansion resulted in an increase of the information content of the universe; the amount of information about the universe still increases, and corresponds, as earlier explained, to the difference between the information about the universe at the point of equilibrium and that which is given us by our current evidence; theoretically, this difference should be proportional to α_w/α.

The concept of the transition states that entropy increases neither in nor with time: entropy increases from cause to effect; this direction coincides with the conventional direction of time, passing from past to future. It might also be remarked that the rediscovery of time allows us to explain Saint Augustine's thesis that the world is created *with* time, not *in* time, while also allowing different physical approaches to time to be reconciled within the ancient philosophical doctrine of three-dimensional time (see, for example, Plato's or Aquinas' concepts of time). Also, it might be remarked that time is a post-equilibrium product of interaction of gravity and entropy (this speculation resonates in the physical literature in the identification of a gravitational arrow of time: as [3] argues, the origin of time's arrow is not necessarily to be sought in initial conditions but rather in the structure of the law which governs the universe). The concept of the transition also allows time to be defined as an agent between gravity and entropy; though based on real physical phenomena, time remains an imaginary value responsible for the rate of change of all processes occurring in the universe. To be clear: gravity is responsible for bounding entropy production through the production of information while entropy is responsible for the quantum supply remaining indifferent both to order and to disorder; although a necessary

factor for evolution, entropy growth alone is not equivalent to evolution—only gravity makes sense of entropy increase in terms of progress in evolution.

The concept of the transition explains an idea of energy as a universal notion that is versatile enough to cover both quantitative 'heat' and qualitative 'love': both these terms meet the literal meaning of energy as the capacity of doing work. This work can be applied either to ensure the integrity of the universe (bound energy) or to ensure its development (free energy increases the amount of free choices). Needless to say that the gravitational fluctuation that once disturbed the equilibrium provided the universe with a structural redundancy that resulted in the continual self-sustaining capability of free choice, which, naturally, makes the system extremely susceptive to variations. In terms of thermodynamics, this disturbance, and the creation of time-space, can be regarded as the launch of the process of transforming gravity into regular matter accompanied by heat release: the universe was forced to work in reverse, in the direction of restoring initial temperature difference while consuming the work produced. In terms of the theorem of minimal entropy production [10], this means that the time-rate (equivalently, the radius) of the electron is nothing but the central attractor providing the universe with the minimum entropy potential that guarantees maximum stability of its subsystems fluctuating in a non-linear hierarchical environment defined by the initial conditions of the universe. As immediately follows from this principle, any motion directed away from the point of equilibrium threatens the stability of the system, and provokes a reduction of non-average fluctuations (the same principle applies throughout and is widely recognized in the scientific literature, although in different forms—for instance, the maximum entropy production principle, Le Chatelier's principle, or Ashby's principle).

Evolution irreversibly proceeds in levels through the interaction of gravity and entropy, that is, the micro-systems of the universe converge to information equilibrium—as information circulates throughout the layers of the universe old equilibriums break down, and new ones emerge. Since Boltzmann's fundamental paper appeared in 1872 a question has repeatedly been raised: How could reversible laws of trajectories of physical bodies coexist with irreversible evolution? The alert reader has probably noticed that, on the one hand, none of micro-systems possesses complete information on appropriate hierarchically related macro-systems: from the standpoint of a micro-system, a related macro-process is irreversible in time. On the other hand, all micro-processes, viewed from the macroscopic point of view, ought to be time reversible, that is, for every micro-state that evolves to the point of equilibrium, there should be one that evolves away from it: reversible rules remain the same when turned upside-down, as Eq. 3 describes. Algebraically speaking, from the standpoint of equilibrium, both processes—$f(t)$ and $f(-t)$— are indistinguishable from each other: the negative sign of the elementary unit of time, as earlier noted, allows micro-processes to be measured in terms of differently directed movement (in principle, considered in terms of the twin-realms concept, this property of time reconciles Loschmidt's reversibility objection with Boltzmann's interpretation of the second law of thermodynamics).

As a matter of fact, there is no novelty in picturing evolution as a twining motion; that is, intelligence is the opposite of entropy, and the Ritz-Einstein battle properly illustrates the case as applied to physics [6]. It is true that intelligence needs information to be stored, and fixing information in a record itself is an irreversible process that generates entropy—the research explains how the information content of the universe was once radically increased without

entropy growth, and describes how exactly the difference between potential and bound information resulted in the structural redundancy of the universe. Since then, one—retarded entropic—process is commonly associated with energy supply, diversification of matter, and randomness; in an expanding universe the total amount of entropy increases, and causes a further fission of matter that concerns the entire hierarchy of the universe: from galaxies to viruses. Accordingly, in the realm of uniformly distributed matter, the efficiency of entropy dissipation depends on the value of specific intelligence (informational potential per unit of intelligent matter, so to speak); it is exactly the second advanced gravitational process that is responsible for the growth of intelligence, and enhancing order in advance. Considered as a whole, these two processes generate the exponentially changing rate of evolution, which closes on itself through the gravity-information loop. Certainly, this dual nature of evolution is manifest in scientific experience: for instance, autocatalytic reactions force a self-organizing system to move in two antagonistic directions between pure dissolution and full saturation, so that in order to survive the system has to occupy the realm between these two extremes, avoiding coming too close to either endpoint (see, for example, [15]). Ontologically speaking, the entropy–gravity interaction uncovers the central dichotomy of nature: pointless existence *versus* knowledgeable behaviour. Evidence of this battle can be clearly observed in nature and is often noticeable in social dynamics: entropy tends to suppress distinctions as much as it can (down to $\hbar_{inf}$) while gravity tends to support the creation of structural redundancy, and organize individual parts of the system in question without denying their identity—the deeper the symmetry of dynamical order, the richer the experience it can give us.

In a sense, the concept of the transition clarifies the *raison d'être* as regards human beings—their origin is a prearranged solution aimed to manage entropic process through maximally possible non-uniform dissipation of self-replicating, self-regulating, and self-eliminating matter capable of carrying information, and producing intelligence in advance [and permitted to exist, as Erwin Schrödinger sternly put it, as long as they pay their entropy debt]. However, one can enjoy a different reality—more appropriate to human thinking—by considering humans as the supreme expression of the self-organization of the universe. It is worth remarking that human behavior can be described in terms of the hypothetical law of the conservation of sense, as formulated in [1]: for a human system the product of force (self-sustainability), time-rate (loosely speaking, bio-rhythms), and knowledge (gravity-informational potential) should be a constant value, which is dependent on the evolution level of the system in question (thus, 'free will' is not free in the strict sense, this is a function of time-rate, force, knowledge, and a fourth hidden variable aimed to synchronize the behavior of separate humans with the rate of evolution).

13. Concept of recurrence

In the most general sense, the evolution of nature is ensured by a permanent exchange of information, which, theoretically, should lead to progressive irreversible increase of knowledge; but this is not priceless: even the imaginary Maxwell's demon does not work for nothing (and it was Leo Szilard who showed that amount of entropy that is lowered due to the work of Maxwell's demon equals or exceeds the amount of information received by this demon). Thus, the price for a recipient of information, be it a quantum or human system, should correspond to the amount of entropy that might be dissipated within the receiving system due to the obtained information—if the disorder of the system in question persistently grows then the particular

system accumulates debts; and if they are not repaid in time the system suffers collapse, for instance, breaking symmetry in the weak interactions as regards physics, or through the extinction of species as regards biology, etc. Our everyday activity implies a perfect confidence in the universality of this law: if the better part of a particular system consists of porters who get drunk on gin by ten o'clock (the metaphor of David Hume) then the system stands a good chance of collapsing before its due time; in other words, if repetitive redundancy is not supported by intelligence then the information stored in the system inevitably degrades, and in case of restoration the system will inherit its properties up to the level of accuracy of the pre-collapse state. Nature can track the situation through direction, continuation, and rate of change as regards the shift between the higher-ordered ultraviolet range and lower-ordered infrared range (this is Eq. 6, that describes the entropic status of the universe in terms of quantum-cosmological mechanics). One way or another, nature explains its irrefutable logic dictated by the quest for survival through equilibrium. In the philosophical literature the point of equilibrium is referred to as the omega-point; this is central to the ancient ontological doctrine of eternal recurrence, known at least in Babylon, and also known to modern mathematics as the recurrence problem; accidently or not, the historical choice of the letters 'omega' (Lambert's constant) and 'alpha' (the fine structure constant) reveals deep cosmological and ontological meanings running through the whole history of human civilization.

With imperturbable insistence, gravity forces all the objects of the universe—from galaxies to elementary organisms—to oscillate on appropriately scaled time-rates caused by the void particle. As this research explains, it is exactly the relation between 'alpha' and 'omega' that defines the outcome of a particular evolutionary process. Metaphorically speaking, alpha is a keyhole in the doorway to the dynamics of the universe, while omega is a key to its stability placed far away from this door—only the knowledge of mutual positions of these 'letters' of nature allows us to make nature-favoured decisions in this regard. In terms of ontology, the algebraic interaction of alpha and omega touches upon an extremely vital question of how determinism (reversibility) and uncertainty (irreversibility) are interrelated. Obviously, the alpha-omega game becomes even more important when played in a delicate and far-from-equilibrium area; this is a special issue of the paradigm of optimization that lies clearly beyond the scope of current physics; however, it is also too important simply to be discarded on these grounds.

Oscillating between the poles of involution (Ω^{-1}) and evolution (Ω), a particular system either accumulates sufficient information capacity which allows that system to compensate entropy growth in a smooth flowing manner, or the compensation avalanches out of a seemingly clear sky. It would be psychologically comfortable to consider these discontinuities as random, but this is not so; this is a law: either information is used or erased. Speaking in terms of dissipative structures, the outcome of equilibrium is defined by the ratio between the rate of averaging (it conserves the system via strengthening traditions; at the extreme, this results in conceptual blindness) and the rate of marginalization (it disturbs the system via enlightenment; at the extreme, this results in midsummer madness). Since nature has learned to make ends meet, it should not come as a surprise that 'blindness' and 'madness' cooperatively attract each other; therefore one should be extremely delicate as regards the interaction of marginal and average elements, especially in far-from-equilibrium states: as follows from the concept of 'order through fluctuations' [9], instead of being corrected by the averages, marginal fluctuations modify those averages, and the more complex the system is, the more numerous are the types of

fluctuations that threaten its stability. If 'alpha' and 'omega' are deliberately adapted then a transition to new level of hierarchy occurs in a relatively soft manner, otherwise the system in question suffers a hard discontinuity. To sum up: a particular information system either succeeds in equilibrium management (in a way favored by nature, and energetically supported by the current flow directed from a higher temperature to a lower temperature level), or immediately shares the fate of black holes.

It is considered that black holes destroy information systems; then there is a further question: is this the ultimate destruction? It appears evident that even if a material object disappears into the throat of a black hole, information about the object must be floating in the universe in the form of cosmic radiation. Certainly, as the object approaches the 'centre' of the black hole this radiation becomes less and less detectable, but, according to this research, physical destruction is restricted within the radius of the void particle, and thus at least the container of the primordial information cannot be physically annihilated. This speculation resonates in the physical literature in the concept of two 'horizons': as many physicists reportedly believe, a collapse of a material object leads to a temporary apparent horizon but not to an eternal event horizon. In its turn, pure algebra gives us clearer confirmations of this assumption. First, we have positive grounds to assume that the topology of the twin-realm gravity-bound universe presents a multiply connected space, which by definition cannot be compressed to a point, that is, a natural end-result of such a mathematic object is to be shrunk to the circumference of the hole. Secondly, viewed from the perspective of algebra, the time-rate and the radius of the void particle—being irrational numbers—can be combined infinitely often; this provides a theoretical *opportunity* for eternal information exchange occurring at the scale of the 'subjective time' of a void particle—timelessness compensates the extremely slow rate of information exchange at extremely low temperatures. Algebraically speaking, due to the irrationality of the values of the void particle there is a non-zero probability that at some moment a void particle will reveal its own nature, crystalized in pure numbers, and will come to light through a point of equilibrium (see, for example, Sakharov's concept of the formation of three-dimensional space in the centre of a black hole as a possible outcome of gravitational collapse in the process of cosmological transition with a change in the signature of the metrics of the universe [11]).

Thus, the universe as a whole cannot reach an absolutely uniform temperature that makes information exchange ultimately impossible. This corresponds to the third law of thermodynamics, which states that no refrigerator can reach absolute zero—that is, there is no force in the universe that can destroy the basic invariance underlying all natural transformations: a void particle that can transform itself into a universe through a pathway of evolution (Eq. 5). The second law of thermodynamics states that the total amount of entropy in the universe always increases (Eq. 1); this research explains that entropy increases from cause to its effect, and this growth is used to maintain the evolution of the universe due to the selection of initial conditions that satisfy the second law; it would also be appropriate to note that since the notion of entropy is senseless without the notion of gravity, this is exactly the information that is central to the understanding of this law, and for understanding how to get around this law without violating it. The first law of thermodynamics, as current physics formulates it, states the conservation of the total amount of matter and energy; the equations presented in this paper describe the universe at the point of equilibrium—all of them manifest symmetries that describe certain aspects of conservation concerning time, matter, space, and gravity-information in the course of their

interactions; however, it is conservation—not motion—that is the only condition of stability of the universe.

Considered as a whole, these three laws define the conceptual basis of a pattern explaining how *a participatory universe* (Wheeler's term) can meet the challenge of the 'heat death', and take an opportunity not to be ultimately plunged in eternal 'freeze death'. Beyond doubt, this pattern foreshadows the modus operandi of nature as engaged in an endless war. Here, we must distinguish between informational (cold) and shooting (hot) wars: the former enjoys structural redundancy leading to better information management while the latter suffers from repetitive redundancy caused by poor information management. Inevitably, each new-coming generation of humans is doomed to deal with entropy growth in the Earth-system, and, as history tells us, either 'gravity' puts new-coming brains to intelligent use, or 'entropy' removes this extra-intelligence from the Earth before its due time. The paradox of this evolutionary paradigm is that whatever contending forces fight for, they fight for the survival of intelligence. Acting in a phoenix-like manner, an intelligent universe sifts out the ashes from the cinders, consistently separating viable grains from clutter in the very egg (in the blackness of a black hole, so to speak) while equally giving each grain a fighting chance to greet itself again—love never faileth.

Although 'love' does not look like a scientific concept, it develops in tandem with all intellectual elements of the universe, making, along with work, the sense of living. The sophisticated fluctuation that once disturbed the equilibrium of the universe resulted in scattering bound information throughout the created time-space; the price for this salvation is the work that is to be done to assemble the scattered bits in order to restore an energy of superior quality—pure as void—capable of conserving information, and giving birth to a new offspring universe. For that cosmological reason, humans are forced to contribute as much as possible to the total informational throughput of the universe: it seems to be evident that evolutionary progress is impossible if one part of the system is unable to communicate with the other part.

14. Concluding remarks

Aiming to explore nature through a combination of algebra and ontology, this research is intended only to be a basis for a prospective discussion in terms of physics. However, certain conclusions can be highlighted. First, all the objects of the universe are related to each other through the special state defined here as the point of equilibrium; these relations are organized in agreement with the conservation laws of nature ensuring the spatial, temporal, and logical integrity of the universe. Second, the singularity inherent in this special state allows us to reveal the analytical relation describing the principal scheme of interaction of fundamental physical forces both in terms of quantum and cosmological scales, and to deduce a system of natural universal dimensionless units based on one and only one invariant quantity—the radius of the void particle. Third, gravity is considered as information that defines the time-space structure of the universe; the evolutionary mission of gravity is the dissipation of entropy that increases as evolution passes from causes to effects; time is defined as a quantified measure of the evolutionary pathway through which the universe passed from the primordial cause to its logical effect, that is, the point of thermodynamic equilibrium. Fourth, the universe can be algebraically described as a dynamical self-regulating non-homogeneous uniformly and hierarchically organized fractal holistic entity that can be explored as a system of pure numbers guided by common laws of rationality.

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