On a fundamental limit to space and time

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In addressing certain challenges of mathematical physics, the paper relies on an idea that physical reality is amenable to a complete description in terms of numerical quantities. What makes that idea extremely relevant to physical theory is that it yields an algebraic pattern that allows us not only to reveal a fundamental limit of the universe, but also to show that it is exactly this quantity that underpins the physical structure of the universe, determines the principles of its conservation and gives rise to all fundamental physical constants.

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1. The fundamental limit

The research to be presented considers that physical reality is amenable to a complete mathematical description in terms of dimensionless quantities. It was Migdal [1, p. 139] who gave us a clue as to how we might address this issue. He suggested that gravity and electrodynamics might be interconnected as follows: $\alpha \cdot \ln\xi \sim 1$, where $\alpha = \frac{e^2}{\hbar \cdot c}$ is the fine structure constant and $\xi = \frac{\hbar \cdot c}{G \cdot m^2}$ is a typical 'large number.' The departure point for this assumption 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 dimensionless physically meaningful independent quantities: α and ξ. Mathematically, $\alpha \cdot \ln\xi = 1$, if $\xi = e^{\alpha^{-1}}$. In turning this identity into an analytical framework, the paper relies on the following recursion:

$$(\alpha) \cdot \left(e^{\alpha^{-1}}\right) \cdot \left(\alpha \cdot e^{\alpha^{-1}}\right) \approx \omega \cdot 10^{115} \tag{1}$$

where $\omega = \mathrm{W}(1) \approx 0.567$ ... W is the Lambert function defined as the function that solves the equation $z = \mathrm{W}(z) \cdot e^{\mathrm{W}(z)}$). To gain an insight into the physical meaning of Eq. 1, we need to take a look at the Lambert function. Along the real axis at the interval $(-\infty, -e^{-1})$ this function is widely discontinuous; for $x > -e^{-1}$ it vanishes identically. Of specific interest to physical theory is that between $-e^{-1}$ and 0 the function has two values $y, \bar{y}$ that exhibit consistent mirror anti-equality (Fig. 1), implying both chirality and complementarity (we say that two mutually exclusive quantities complement each other if they constitute a complete physical and logical system and each quantity has a unique property that another ultimately misses, e.g., right and left). Given that argument precedes function value, $x \in [-e^{-1}, 0)$ can be thought of as a causal variable that yields two mutually complementary outcomes: y and $\bar{y}$; that is, x can be thought of as underpinning two mutually complementing chiral physical quantities, e.g., clockwise and counter-clockwise rotations, y and $\bar{y}$. Physically, the triad $x, y, \bar{y}$ describes an idealized equilibrium at which a physical process ($x \longmapsto y$) and its exact reverse ($x \longmapsto \bar{y}$) completely cancel each other out. Mathematically, $y, \bar{y}$ are determined in a simultaneous manner (if x is known, then y and $\bar{y}$ are also known at once). In physics, the things are different: a physical entity (e.g., the spin of an elementary physical particle) cannot be clockwise and counter-clockwise at once, making it impossible to foreknow which spin will be left-handed and which right-handed. For that very reason, quantum mechanics relies fundamentally on probability. Of specific relevance to that method is the branch point of the Lambert function $(-e^{-1}, -1)$, because this point is central to both probability and self-similarity. The number $1 - e^{-1} \approx 63.2\%$ determines the probability that a permutation of many elements will have at least one fixed point (an element equal to its image), which means that a physical quantity remains invariant under scale transformations, implying self-similarity (self-identity). In physics, the number $|-e^{-1}|$ determines the time constant ($\approx 36.8\%$) that is used to measure the thermal responsiveness of a physical system while the number $1 - e^{-1}$ determines change in the energy state of the physical system: this quantity determines the time it takes the output of an electric process to change by $\approx 63.2\%$ of the peak-to-peak amplitude on every phase transition. The above gives us certain grounds to assume that the number $-e^{-1}$ somehow connects the concepts of electrodynamics, invariance, probability, self-similarity, thermodynamics and time. In addressing this issue, it should be taken into consideration that the number $-e^{-1}$ underpins the number 0. Mathematically, 0 lies exactly between the numbers $+1$ and -1; these numbers are full (additive and multiplicative) inverses of each other, which is what the Lambert function reveals: $-1 = \mathrm{W}(-e^{-1})$, $+1 = \mathrm{W}(e)$.

If the causal variables $x \in [-e^{-1}, 0)$ describe a statistical behaviour of quantum objects, then the branch point $(-e^{-1}, -1)$ describes a chiral twist in this behaviour. Mathematically, this twist describes a bifurcation into two fundamental singularities. The bottom branch of the Lambert function W_{-1} tends to $-\infty$ as x tends to 0^- (negative singularity) while, at the same time and for the same $x \in [-e^{-1}, 0)$, the principal branch of the function W_0 tends to $+\infty$ (positive singularity).

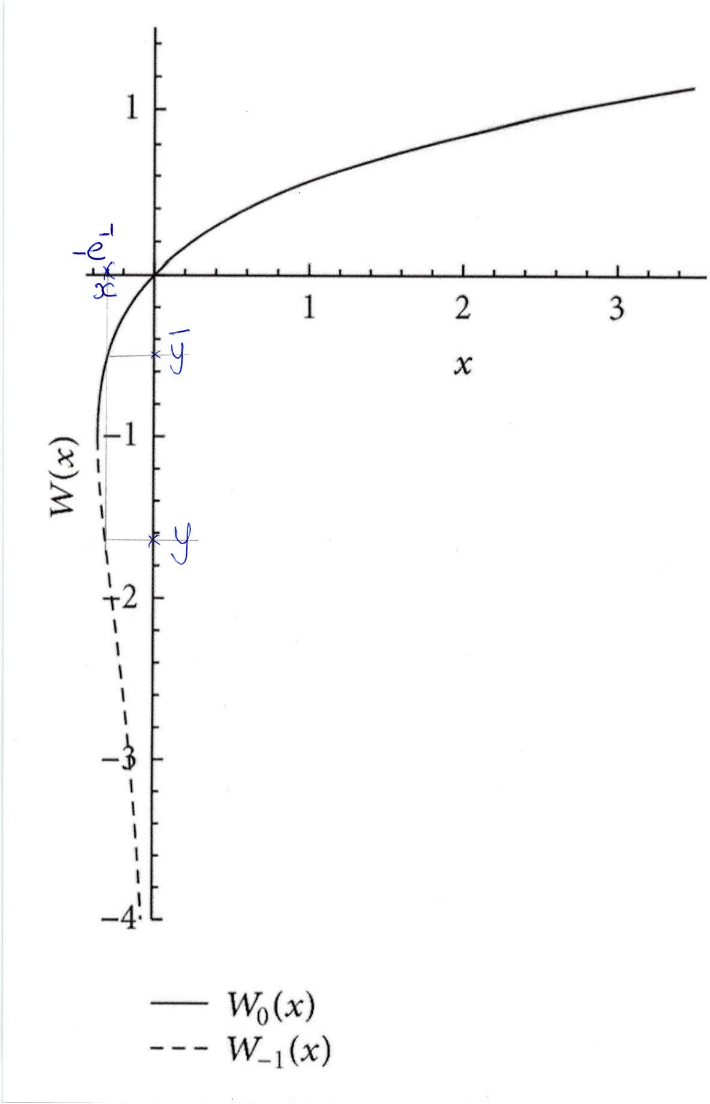

Fig. 1. The Lambert function and its two branches

Mediating between $\pm\infty$, the twist in question implies the sign interchange $\pm$, which is manifest in 0 that lies at the heart of an absolutely symmetric construct known as the Cartesian coordinate system. All indications are that the above gives us a clue as to how 0 and a fundamental limit relate to each other. That is, the Lambert function describes a physically interpretable statistical distribution of mathematical variables (the causal variables); the core of this distribution is the branch point of the function $(-e^{-1}, -1)$; this point yields 0 and by the same token determines the boundaries within which the causal variables $x \in [-e^{-1}, 0)$ vary; therefore, one of these variables, an exceptional one, is necessarily anchored to the limit in question.

To reveal that limit, we need to return to Eq. 1. Given that it describes an approximation of equilibrium, its exact solution can be written as the following strict equality:

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

Solving this equation reveals that it has three real roots; all of them derive from the omega constant ω only:

$$\mp x_{1,2} = \mp R_w = - \mathrm{W}_0{}^{-1} \left(\pm R_w^{-1}\right) \text{ and } x_3 = \alpha_w = - \mathrm{W}_{-1}^{-1}\left(- R_w^{-1}\right) \quad (3)$$

where $R_w = \alpha_w \cdot e^{\alpha_w^{-1}} = |\sqrt{10 \cdot \omega}| \cdot 10^{57}$ (in what follows, upper-case letters denote the macro-scale of the universe while lower-case ones its micro-scale). Note that the third root $x_3 = \alpha_w \approx 7.29739 \ldots \cdot 10^{-3}$ is remarkably close to the currently accepted value of the fine structure constant $\alpha_c \approx 7.29735 \ldots \cdot 10^{-3}$ (in what follows, the low index 'c' reads 'current,' which is interpreted as the running value of a physical quantity; that is, $\alpha_w = \alpha_c$ corresponds to perfect equilibrium). To remind, equilibrium, by its very nature, implies complete coincidence of an object with itself; such state can be attained via a series of identity transformations, implying approaching self-similarity (which is precisely what the modus operandi of the Lambert function implies and this becomes perfectly obvious if we represent the function as a series of continued logarithms). Mathematically, self-similarity of a unique specimen (say, R_w) can be written formally as follows: $R_w^{-1} \cdot R_w = 1$. The physical meaning of this identity reveals itself via the fine structure constant. Given the frequency-like nature of this quantity, the left-hand terms of Eq. 2 can be thought of as describing three pillars of mechanics: contraction-extension (x), rotation ($e^{x^{-1}}$) and translation ($x \cdot e^{x^{-1}}$), where $x = \alpha_w$. Given such insight, the term $R_w = \alpha_w \cdot e^{\alpha_w^{-1}}$ can be thought of as defining an upper limit of translational force; accordingly, its reciprocal R_w^{-1} can be thought of as defining its lower limit, which is what the concept of physical limit essentially implies: the minimal wavelength, contributing to the zero-point energy and describing the lowest energy state of physical void.

2. Quantum interactions

The above makes it possible to gain a fresh insight into the way in which fermions and bosons interact with each other. It is considered that asymmetric fermions make up matter and take up space; they have half-integral spins and obey the exclusion principle, implying that fermions can have either left- or right-handed spin, but not both at once. Symmetric bosons carry energy; they neither make up matter nor take up space; they have integral spin and do not obey the exclusion principle, implying the symmetric nature of physical conservation. Of relevance to that connection is that $x \in [-e^{-1}, 0)$ yields two non-integer values y, $\bar{y}$, which can be associated with non-integer single-valued spins, describing the asymmetric behaviour of fermions. The Lambert function also tells us that for the same real argument there exists an infinite number of complex multiple-valued solutions $\mathrm{W_n}(z)$, where $\mathrm{n} \in \mathbb{Z}$. These solutions can be associated with the integer values of spins and multiple degrees of freedom, which describes bosons' behaviour. Central to quantum theory is that that construct maps the asymmetry of fermions into the symmetry of bosons, making it possible to depict quantum dynamics as arising from particle-like asymmetric distribution of the causal variables (associated with fermions and the past), amplified by oppositely directed higher order field-like symmetric correlations (associated with bosons and the future). According to our convention, the lower limit of this process is $\pm R_w^{-1}$ and its upper limit is $\mp R_w$. What should be perfectly obvious here is that the sign interchange does not mean that physical energy can be negative or positive; what it (the sign) means is that physical energy arises from clockwise or counter-clockwise spin rotation, resulting in two counter-rotating quantum domains of the universe. Which is but natural: since left and right are equally consistent with nature, both right and left ought to be part of a unified whole. These two domains are mathematically interconnected via the branch point of the Lambert function $(-e^{-1}, \mathrm{W}(-e^{-1}))$ that concurs with both 0 and the physical equilibrium at which two fundamental statistics (Fermi-Dirac and Bose-Einstein ones) converge with each other, implying that all physical forces derive from a common ancestor. Thus, the causal variables $x \in [-e^{-1}, 0)$ describe quantum information, associated with fermions; the end-points of this interval correspond to a chiral twist via which this information increments and bifurcates; the resulting energy fluxes are mutually compensated, so that the total entropic balance within the system remains constant; a series of the resulting successive equilibriums ensures a smooth variation in the order of magnitude, standing behind the energy transfer within the space-and-time continuum.

Of relevance to physical theory is that the construct just sketched forces us to distinguish between two concepts of infinity: spurious (secondary) mathematical infinity and its underpinning genuine (primary) physical infinity. Deriving its existence from the notion of imaginary mathematical nothing 0 (null), the former is relevant to the notion of perfect equilibrium, implying reversibility and symmetry; the latter derives its existence from the notion of real physical nothingness R_w^{-1} (zero), which is relevant to non-equilibrium, implying irreversibility and asymmetry. In what follows, the paper considers this logical nexus in terms of the concept of time.

3. Clocks and time

Time is associated with change and duration. According to Eq. 2, physical change takes its rise in the contraction-extension of the electron (α_w, further referred to as the time-rate of the electron), which results in rotational and translational motions of quantum particles. Physically, this equation describes a coherent transition of quanta from the initial state of the universe $\pm R_w^{-1}$ to its boundary state $\mp R_w$, implying cause and effect, respectively. Given that it takes duration to bridge these states, it is possible to conceptualize time as an imaginary mathematical quantity that determines the rate of change and direction of rotation of real physical objects as they pass from cause to effect. The roots of Eq. 2 ($\alpha_w, \mp R_w$) tell us that differently rotating quanta are synchronized via the same mathematical variable α_w, which is manifest in the clockwise and counter-clockwise quantum domains $\mp R_w$. Since these domains are interconnected in a chiral manner, an observer in either domain recognizes physical processes in the counter-rotating domain as occurring in opposite direction. Thus, from the perspective of that observer, time flows as if in two directions at once, which seems paradoxical, forcing us to explain the following contradiction: mathematical physics depicts time as reversible and symmetric, but time as we perceive it is asymmetric and irreversible; it always passes from cause to effect and never in the reverse, as our life experience and the second law of thermodynamics tell us.

Thus, differently rotating quantum particles evolve into two mutually compensating counter-rotating quantum vortexes; the causal order of that process is determined by the causal variables $x \in [-e^{-1}, 0)$ in an irreversible linear fashion. If these variables take the value of null ($x = 0$) and do not change, then we adopt the concept of spurious time (clock-time), as is currently the case in physics. Such time describes a causeless imaginary world in which entropy increases when clock hands are moving; accordingly, when clock hands stay put, it is considered that entropy remains constant, which is at odds with what is observed in reality: actually, we observe that entropy monotonically increases with time and it cannot be otherwise, because time, genuine time, irreversibly passes from cause to effect. From the above, it follows that it is reasonable to differentiate between clock-time and genuine time. What should be perfectly obvious is that clock-time is strictly limited to equilibrium situations: it depicts a real dynamical process as an idealized approximation of successive equilibriums. Real physical dynamics derives from and occurs in non-equilibrium environments only, implying that the causal variables $x \in [-e^{-1}, 0)$ cannot but change; otherwise, physical motion could not be possible. Given the above, we are able to claim that genuine time is relevant to irreversible cyclical information increment while spurious clock-time to an imaginary state at which this information bifurcates, equilibrating differently rotating quantum particles. Associated with the term 'now,' this construct makes it possible to distinguish between the past, the present and the future, which is recognizable at the level of consciousness.

4. The roots of physical conservation

The roots of Eq. 2 are amenable to interpretation in terms of conservation laws. That is, the invariance of α_w implies the law of conservation of energy and homogeneity in time (translation symmetry); the invariance of $\mp R_w$ implies the law of conservation of linear momentum and homogeneity of space (the symmetry of translational forces). As Eq. 2 describes, the former (time) and the latter (translational forces) are bridged via rotation ($e^{\alpha_w{}^{-1}}$), which perfectly conveys the meaning of the law of conservation of angular momentum and isotropy of space. It is not immediately evident, but in order to interpret these laws in terms of quantum mechanics, we need to consider all four remarkable algebras in their cohesiveness (these algebras are the one-dimensional real numbers, the two-dimensional complex numbers, the four-dimensional quaternions and the eight-dimensional octonions).

According to our convention, the real numbers describe a one-dimensional distribution of the causal variables over the real axis; that is, these numbers describe the potentiality of real physical objects, implying that space is real. Then, the imaginary numbers can be thought of as describing a change of these variables in time, reflecting the imaginary nature of time. Given that the information that describes the space-like and the time-like constituents of physical energy originates from the same point zero, it is natural to bridge them via the complex numbers, entailing that physical conservation is effectively two-dimensional. What is worth noting in that connection is that the complex number multiplied by its conjugate (squaring) always yields a non-negative real number, implying that energy remains real under any transformations; which is what the first law of thermodynamics states: energy can be neither created nor destroyed, but only changed from one form to another. The next mathematical milestone in that construct is the algebra of quaternions; it adds three-dimensionality, rotation and irreversibility, but the quaternions are irrelevant to causality. It is the algebra of octonions that extends the quaternions to causality; and that is where the non-associativity of the octonions becomes indispensable for describing reality (the octonions are neither real nor commutative nor associative, implying imaginariness, irreversibility and causality, respectively). In what follows, the paper shows how exactly that eight-dimensional algebraic structure bridges the cosmological (macroscopic) and quantum (microscopic) scales of the universe.

The mathematical formalism provided by the eight-dimensional algebra allows us to define a quantum state of a physical object as follows:

$$\pm \Delta + \alpha_w i + G_w j + R_w k + \Omega l + m_w il + l_w jl + t_w kl = \psi_w \tag{4}$$

It is worth repeating that the time-like microscopic α_w and the space-like macroscopic $\mp R_w$ constitute an algebraic triad that synchronizes rotation and translation of physical forces via time (the time-rate of the electron). Given that the macroscopic and microscopic physical units are interconnected in a manner of mathematical reciprocity, we are able to determine the microscopic unit of rotation via its macroscopic equivalent $e^{\alpha_w^{-1}}$ as follows $\alpha_w = \ln^{-1}(e^{\alpha_w^{-1}})$. Here it is appropriate to remind that current physical theory claims that gravity is essentially a curve in the geometry of the space-and-time continuum caused by mass; that claim makes it possible to associate $e^{\alpha_w^{-1}}$ (rotation) with gravity; accordingly, its micro-equivalent α_w can be thought of as the gravitational mass of the electron. From the above, it follows that the time-rate of the electron α_w uniquely specifies its gravitational mass: $\alpha_w = m_w$, which establishes a mathematical identity between time and matter; which is parallel to a viewpoint that inertial mass is proportional to gravitational mass, implying the equivalence principle. Given that gravity is associated with rotation, we are able to claim that Eq. 2 describes the following causal link: time (contraction-extension) precedes gravity (rotation) and both precede translational (inertial) forces. That is, whenever one claims that the masses of the elementary physical particles create gravitational fields, this should not be understood in the sense that mass causes gravity; quite the opposite: it is gravity that causes inertial mass. Also, it should be perfectly obvious that until the causal nature of time remains unrevealed, it is conceptually and mathematically impossible to differentiate the effects of inertia-translation from those imposed by gravity-rotation. To appreciate this claim, it makes sense to take a closer look at the fourth term of Eq. 2 ($\Omega = R_w^2 = \omega \cdot 10^{115}$). Given the physical meaning of Eq. 2, this term can be interpreted as the duration it takes gravity to shape the physical structure of the universe; that is, to bind the quantum information that ensures a transformation of quantum particles from $\pm R_w^{-1}$ to $\mp R_w$. Thus, the fourth term complements time with duration, which makes it possible to turn the notion of time-rate into a full-fledged concept of time that combines rate of change with duration—time as we know it. Standing apart from all its constituents and fully accounting for their contributions to the total energy content of the universe, the fourth term Ω stands behind the physical conservation across the entire universe: it bridges the zero-point energy of void (the 'micro') and the total energy content of the universe (the 'macro') in an explicit manner: $R_w / R_w^{-1} = R_w^2 = \omega \cdot 10^{115}$, which clarifies the essence of the cosmological constant problem.

Logically, our next concern is to define not only the microscopic unit of mass, but also the microscopic unit of length and that of time. Given Eq. 2, the fundamental microscopic units can be defined as follows: $m_w = \ln^{-1} G_w$ (mass), $l_w = \ln^{-1} R_w$ (length), $t_w = \ln^{-1} \Omega$ (time), where $\Omega = R_w^2$, $G_w = e^{\alpha_w^{-1}}$, $R_w = \alpha_w \cdot e^{\alpha_w^{-1}}$.

Returning to Eq. 4, the term $\pm\Delta$ implies that the universe comprises two counter-rotating quantum domains $\pm R_w$; this delta stands for the value of displacement (relative to 0, the only exact middle between R_w and $-R_w$) while its sign indicates direction of rotation of the physical object; the terms *i, j, k, l* are imaginary units such as $i^2 = j^2 = k^2 = l^2 = -1$; and ψ_w denotes the quantum state of the object in question. Thus, Eq. 4 translates the classical laws of physical conservation into the language of quantum mechanics, namely, α_w implies conservation of energy and homogeneity in time; m_w implies conservation of angular momentum and isotropy of space; l_w implies conservation of linear momentum and homogeneity of space. The fourth term t_w ensures synchronization of physical processes at the microscopic scale of the universe. In terms of geodesics, Eq. 4 describes how exactly time causes matter to gravitate towards the point of their common origin in the shortest way possible, which allows us to consider the principles of causality, least time and least action in their cohesiveness. In terms of topology, Eq. 4 describes a rotation of quantum objects on a double twisted surface on which it takes two circuits to compensate the contribution of their zero-point energies, which is what Eq. 3 tells us: $\mp R_w =- \mathrm{W}_0{}^{-1}\ (\pm R_w^{-1})$. Which explains why electrons, and other fermions, return to their original orientation after 4π −rotation in space: it is such type of rotation that strikes an exact balance between the identities shared by coupled objects, such as fermions and their chiral quantum twins.

Given the above, it is safe to say that time runs at different rates. Every quantum system operates at its own time scale; gravity and translational forces are synchronized via time at all scales of the universe. Time and gravity are in inverse exponential dependence: $G_w = e^{\alpha_w^{-1}}$. Gravity causes inertial mass; the time-rate of the electron α_w plays an exceptional role in setting the mathematical identity between time and matter $\alpha_w = m_w$. Gravity precedes translational forces. The operational range of gravity exceeds that of translational force by $\alpha_w^{-1} = {}^{G_w}/_{R_w}$. The quantity α_w^{-1} is amenable to interpretation in terms of Boltzmann's entropy formula: $S = k \cdot \ln W$. Given that $W = G_w$ is the number of all possible quantum states and that void itself produces neither translational motion nor action ($k = 1$), the term $S = \alpha_w^{-1}$ can be interpreted as the free (initial, negative) entropy of the electron, its gravitational potential, implying a measure of the quantum information that is to be bounded to produce the energy that gives rise to the entire energy content of the universe.

Mediating between time and matter, gravity compartmentalizes unbounded quantum information, setting order in advance of translational forces. As quantified information circulates throughout the layers of the universe, old equilibriums fade and new ones emerge—combining the principles of least action, least time and causality, gravity generates only true messages, that is, only those messages that connect the past and the future states of the universe in the shortest way possible. If gravity suddenly disappeared, these states could not be connected and the entire physical universe would collapse, in full accord with the second law of thermodynamics. That is the physical meaning of gravity. Of relevance to the second law, and the semantics of physics in general, is that meaning as such confers no entropic burden—it takes intangible time rather than tangible clocks to generate meaning, implying that it takes semantics (causation) rather than syntax (correlations) to discern between intangible and tangible entities, such as clocks and time, real and imaginary, null and zero, and many other fundamental complementarities that constitute a realm of meanings, including physical knowledge. It is commonly thought that semantics lies far beyond the scope of physics. Which is true, but it is also true that it is exactly semantic information that lies at the heart of nature, remaining central to understanding physical theory.

5. Untwining quantum entanglement

Since the meaning of null and that of zero are discerned, we are able to explain the phenomenon of quantum entanglement. To remind, a quantum pair is said to be 'entangled' if each object of the pair cannot be described independently of the other and these objects are perfectly correlated to each other, no matter how distant they are from each other (e.g., if one spin is right-handed, then its paired spin is invariably left-handed). This phenomenon has long been a stone of stumbling for physicists, because no information can travel faster than the speed of light. The point is that no information transfer is required to know the quantum states of the entangled pair, because this information is embedded into the gravitational contour of the universe at its fundamental level $x \in [-e^{-1}, 0)$. If neither y nor $\bar{y}$ causes each other and the two are mutually correlated, then there must exist their common cause, which is what their common argument x implies: x determines y and $\bar{y}$ simultaneously and independently from each other. Physically, the states y and $\bar{y}$ cannot be measured simultaneously, but this impossibility in no way entails that they cannot be known simultaneously. As is perhaps already clear, similar difficulties arise when it comes to the principle of quantum superposition. Loosely speaking, it claims that until a quantum object remains unobserved, it is in a state of superposition, implying that it exists in all possible states at once. Which is physically impossible. It is true that until certain quantum information is not actualized, it is impossible to observe which spin is left-handed and which is right-handed, but this does not entail that a spin rotates in all directions at once. The exact direction of that rotation becomes observable when quantum separation occurs, which implies that certain statistical condition has been fulfilled and certain quantum information has been released. When such event occurs it becomes possible for physicists, and other observers, to observe what is observable in the domain of their original handedness. According to our convention, quantum information becomes actualized via a quantum twist that mathematically concurs with the branch point of the Lambert function $(-e^{-1}, \mathrm{W}(-e^{-1}))$. Physically, this event describes quantification and separation of primordial formless void into two counter-rotating quantum domains, which is manifest in a turn (π −turn) between 1 and $\bar{1}$ ($e^{2\pi i} = 1 = \mathrm{W}(e\ )$ and $e^{\pi i} = -1 = \mathrm{W}(-e^{-1})$) or, we may say, between two mathematically indoctrinated infinities $\pm\infty$. In physics, this event is necessarily addressed in terms of null-based continuous mathematics, which makes the wave function reduction (ψ −collapse) unavoidable: responding to discontinuity, any continuous function necessarily fails to evince its continuity; speaking in more general epistemic terms, it is cause (zero) that precedes effect (null); therefore, the effect consistently declines to be identified as the cause, which is exactly what the reduction of the wave function reveals. To the above, it may be added that it is a common practice for physicists to address the probability of a quantum event as the modulus squared of its amplitude ($|\psi|^2$). This trick reduces thinking to syntactic solutions, foreclosing a possibility of inquiring into their meanings; which is also true of infinity: many efforts have been made to expunge the symbol '∞' from the equations of physics, but this syntactically correct move remains futile as long as the provenance and the semantics of mathematical infinity remains unrevealed.

6. Substantiating syntax with semantics

The above gives us sufficient grounds to think that syntactic solutions make sense only against meaning, which, in particular, makes it possible to recognize that mathematical nothing (null) and physical nothingness (zero) are two mutually complementing components of the same reality. Once this claim is properly appreciated, then division one by zero becomes physically and mathematically meaningful, it yields neither infinity nor indefiniteness, it yields $R_w = (R_w^{-1})^{-1}$. Semantically speaking, it is R_w^{-1} rather than 0 that specifies the maximum of physically realizable force R_w that is actualized in the process of becoming Ω, which can be written formally as follows: $R_w = R_w^{-1} \cdot \Omega$.

Clearly enough, to argue that the universe emerged from the mathematical nothing is tantamount to claiming that physical space is imaginary. This paper hews to the view that physical world exists in reality, which, in particular, entails that physical container of information can never be annihilated. That is, there always exists a physical possibility for information exchange, implying that everything in space is in motion, which is what the third law of thermodynamics states: the absolute zero, implying null, is physically unattainable. Mathematically, the entire physical dynamics of the universe derives from the alpha constant α_w that, in its turn, derives from the omega constant ω. Because of irrationality, one can combine these numbers infinitely often, which creates an apparent challenge to physics: infinity is not amenable to measuring. In addressing this challenge, it is semantically relevant to negate infinity with infinity, which is what the self-similarity of space-and-time $R_w^{-1} \cdot R_w = 1 = \alpha_w^{-1} \cdot \alpha_w$ implies, thus making it possible to address physical theory in the terms of finite quantities.

7. The fundamental interactions

All syntactic information that describes the physical structure of the universe is encoded in numbers, the rest is meaning. In particular, it is the meaning of self-similarity that is crucial to describe how the fundamental physical forces interact with each other. The point is that the self-similarity of the space-and-time continuum ($R_w^{-1} \cdot R_w = 1 = \alpha_w^{-1} \cdot \alpha_w$) derive from the same invariant ω, which allows us to address space-like and time-like constituents of that continuum in terms of a common framework; at the heart of that framework lies the identity of time and mass $\alpha_w = (\alpha_w^{-1})^{-1} = m_w$. Formally, a parity between two variables, say, α_w and ω can be written as follows: $\frac{\alpha_w \cdot \omega}{\alpha_w} = \omega = \frac{\alpha_w \cdot \omega}{\alpha_w}$. Mathematically, the number ω and the number e are interconnected as follows: $\omega \cdot e^{\omega} = 1 = \omega^n \cdot e^{n\omega}$ $(n \in \mathbb{Z})$. On the basis of that claim, it is mathematically possible to deduce an analytical relation between the time-rate and the mass of the electron as follows:

$$\frac{\alpha_w \cdot \omega}{\alpha_w} \cdot e^{\alpha_w \cdot \omega / m_w} = 1 = \frac{\alpha_w \cdot \omega}{m_w} \cdot e^{\alpha_w \cdot \omega / \alpha_w} \qquad (5)$$

The logic of the present research reveals that the middle term of Eq. 5 exactly equals the macroscopic radius of the electron $R_e = 1$ (to remind, upper-case letters denote the macro-scale of the universe while lower-case ones its micro-scale). Here we should clarify the line of reasoning underpinning this deduction, and those that are to follow. The macroscopic units are associated with their microscopic equivalents; in particular, the macro-equivalent of the quantum of action, the maximum of physically realizable action of translational force R_w, is associated with the speed of light. In classical physics, the radius of the electron is calculated as follows: $r = \alpha \cdot \lambda$, where $\lambda = \hbar / _{mv}$. Given that the macroscopic equivalent of the speed of light is $v = c = R_w$ and $\alpha = \alpha_w, m = \alpha_w$, $\hbar = R_w$, we can determine the macroscopic radius of the electron as follows: $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$. Next, the parity of reasoning allows us to extend Eq. 5 into the field of other elementary physical particles as follows:

$$\frac{\alpha_w \cdot \omega}{\alpha_p} \cdot e^{\alpha_w \cdot \omega / m_p} = R_p = \frac{\alpha_w \cdot \omega}{m_p} \cdot e^{\alpha_w \cdot \omega / \alpha_p} \quad (6)$$

where α_p, m_p, and R_p are the time-rate, the mass and the radius of an elementary physical particle (p). Logically, one can calculate the time-rates and radii corresponding to the unique masses of distinct elementary physical particles by substitution into Eq. 6 of appropriate values given in the units of the electron-masses. As it follows from these substitutions, each unique mass has two real roots; that is, mathematically speaking, any elementary physical particle constitutes an algebraic pair, consisting of two conjugated quantities interconnected through the electron joint $R_e = 1$ (Table 1).

Table 1. The time-rates (α_p, A_p^D) and radii (R_p, R_p^D) of certain remarkable elementary particles (R_e and r_e are the electron radii at the macro- and micro-scales, respectively)

The elementary particle	α_p	R_p	A_p^D	R_p^D
…			…	…
'Dark' proton			≈ 0.00039…	≈ 10.43…
'Dark' pion			≈ 0.00049…	≈ 8.59…
'Dark' gamma-quantum			≈ 0.00055…	≈ 7.67…
Electron (e) and its 'dark' twin	$= \alpha_w$	= 1 (R_e)	≈ 0.00256…	≈ 2.84…
Gamma-quantum (γ)	≈ 1…	≈ 0.00414… ($2r_e$)		
Pion (π^+)	≈ 2…	≈ 0.00207… (r_e)		
Proton (p^+)	≈ 13.4…	≈ 0.000309…		
…	…	…		

Mathematically, Table 1 describes an inverted algebraic pattern designed in such a way that for every elementary physical (quantum) particle its time-rate increases as its radius decreases in one realm while in the other realm the time-rate decreases as the radius increases, so an action in one realm reciprocally induces a counter-action in the other, in such a way that these realms unceasingly induce each other's existence. Thus, two mutually conjugated right-handed and left-handed microscopic worlds exist simultaneously, affecting each other via the electron joint $R_e = 1$. In bridging these worlds, this joint serves as an attractor towards which differently rotating quantum particles tend to evolve. Step by step, physicists explore the microscopic world that surrounds them (left lower part of Table 1) while its inverse remains a dark side of the universe amenable only to crude approximation (right upper part of Table 1). What makes that pattern particularly relevant to physics is that it allows us to deduce major dimensionless quantities of the electron (Table 2).

Table 2. Major dimensionless quantities of the electron

Quantity	Macro-scale	Micro-scale	Source formula
Quantum of action ($R_w, \hbar_w$)	$\alpha_w G_w$	$\alpha_w \omega$	See below
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 (Λ_w, λ_w)	α_w^{-1}	$\approx \frac{\omega}{2}$	$\lambda = \frac{\hbar}{mv}$
Charge ($-, e_w$)	$-$	$\approx \pm\sqrt{2\alpha_w^2\omega}$	$\hbar = \frac{e^2}{\alpha v}$
Bohr radius (A_0, a_0)	α_w^{-2}	$\approx \alpha_w^{-1} \cdot ½\omega$	$a_0 = \frac{\hbar}{mv\alpha}$
Angular momentum (for a circular Bohr's orbit, L_e, l_e)	G_w	ω	$L_e = mva_0$
Ratio 1: quantum of action to angular momentum	α_w	α_w	
Ratio 2: classical radius to Compton wavelength	α_w	α_w	

Here we should pause to explain how the microscopic velocity v and the microscopic quantum of action $\hbar_w$ are defined. The microscopic velocity is defined as follows: $v = \frac{l_w}{t_w} \approx 2.000264$ … further referred to as ≈ 2, which is the classical representation of velocity of a material body moving in Euclidean space: distance divided by time. The micro-quantum of action is defined as follows: $\hbar_w = \alpha_w \cdot \omega$, which can be interpreted in the following way: given that α_w is the reciprocal of the Compton wavelength of the electron $\Lambda_w = \alpha_w^{-1}$, its frequency-like equivalent α_w can be thought of as describing the changeability of the universal quantum vortex in time while the angular momentum of the electron ω (Table 2) stands for its rotational invariance, implying the angular momentum conservation; thus, the micro-quantum of action sets a one-to-one correspondence between individuated ($\propto \alpha_p$) values of the time-rates of the quantum particles and the angular momentum of the electron. On the basis of this claim, it becomes possible to define the quantum of action of a microscopic quantum participle (p) as follows: $\hbar_p = \alpha_p \cdot \omega$. To define the gravitational radius of the electron (Table 2) we rely on Schwarzschild's equation; the radius in question is deduced from the following substitutions in this equation: $G = G_w, m = \alpha_w, c^2 = R_w$ (the macro-scale) and $G = \omega, m = \alpha_w, v^2 = 4$ (the micro-scale), respectively. What is worth noting here is that Schwarzschild's solution is relevant to stasis, which is exactly what the concept of perfect equilibrium $\alpha_w = \alpha_c$ implies.

In principle, if the Compton wavelength (λ_p) of an elementary physical particle is known, one can calculate its microscopic radius as follows: $r_p = \lambda_p \cdot T_p \cdot R_p$, where the right-hand terms are the Compton wavelength (microscopic dimensional), the time-rate and the radius of the elementary physical particle (macroscopic dimensionless), respectively. Given Table 1 and the data obtained through empirical research [2], one can calculate the radii of any elementary physical particle, for example, for proton ≈ $\frac{0.842\ldots}{1000}$ fm, pion ≈ $\frac{0.585\ldots}{100}$ fm, electron ≈ $\frac{2.818\ldots}{1}$ fm, which makes it possible to bridge dimensional physical quantities with their dimensionless equivalents (note, the factor of ten should be taken into account). Also, note that two ratios (the lower part of Table 2) are put in the table to highlight the exceptional role of the alpha constant in bridging physical fundamentals: $\frac{R_w}{G_w} = \alpha_w = \frac{\hbar_w}{\omega}$; reciprocally, it is inconceivable not to appreciate the role of its underpinning omega: $\frac{\hbar_w}{\alpha_w} = \omega = \frac{\hbar_w}{m_w}$.

Physical interactions arise from differences in energy levels between quantum particles with a universal tendency to the lowest energy level of the universe, implying equilibrium. Given that $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$ is a mathematical manifestation of physical equilibrium, and drawing on Table 1, it is logical to assume that the fundamental physical interactions should be based on the following reciprocation: if the value of the Compton wavelength α_c^{-1} increases then the value of the time-rate α_c decreases (in this case, the strong forces prevail: they conserve atom's integrity and provoke gain in gravity); the weak forces act in a reciprocal manner: they stimulate nuclear decay and compensate gain in gravity. To give the above a concrete physical footing, it is reasonable to take a closer look at the four remarkable elementary physical particles (Table 1). These particles specify the ranges of action of the fundamental forces that are manifest in their time-rates and radii for: (i) the electro-magnetic forces that act within the electron e and the gamma-quantum γ layers (α_w, 1 and 1, $2r_e$); (ii) the strong forces that act within the γ and the pion π^+ layers (1, 2 and $2r_e$, r_e); and (iii) the weak forces that act beyond the Yukawa potential that is restricted by the π^+ and the proton p^+ layers, where the latter (the proton-layer) closes the gravity loop via the radius of the proton and the zero-point energy R_w^{-1} as follows:

$$R_{proton} \approx \frac{\alpha_w}{R_w} \cdot 10^{56} = \frac{1}{G_w} 10^{56} \tag{7}$$

From the above, it follows that the electro-magnetic and nuclear forces constitute a single translational force: acting within different energy layers, these forces are manifest in different time-rates and therefore in different quanta of action. The above makes it clear that it is the weak interactions that constitute the weakest link in the gravity contour of the universe as against the strict determinism inherent in the electro-magnetic and strong forces, which is manifest in the attractor $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$. Given the above, it is safe to say that quantum chirality underlies asymmetry at all scales of the physical universe: from weak quantum interactions that recognize a distinction between left- and right-handedness to cosmic parity violation, associated with spiral galaxy spin asymmetry. Therefore, it is but natural to expect that the parity violation inherent in the weak quantum interactions should manifest itself on the cosmological scale; and we have sufficient grounds to assume that the slight lop-sidedness (dubbed the cosmic 'axis of evil') that is observed on the very large cosmological scale owes its origin to this symmetry violation as applied to the macroscopic scale of the universe, and, as astrophysical observations show, there exists the macroscopic attractor (dubbed the 'great attractor') on the other side of the Milky Way (the chirality in question also explains why the solar system has the preferential, conventionally, counter-clockwise rotation while both clockwise and counter-clockwise objects are possible within a star system).

The concept of the attractor implies a perfect order that exists as if outside physical reality. Which needs to be explained: dynamics, in its physical sense, is distinguished only if it is measured up against a fixed frame of reference being at absolute rest; clearly enough, such frame cannot be physical part of its physical environment—it can exist only in imagination, implying $\alpha_c = \alpha_w$. Physical dynamics can emerge only if $\alpha_c \neq \alpha_w$, which implies that quantum particles ought to move, making it possible for matter to emerge and to exist for a time. In certain existential sense, α_c describes realities of the world while α_w implies its ideal state; and if a physical process spins out of control, it is if an unknown power returns it to self. Cosmologically, the difference between α_c and α_w ($\approx 4 \cdot 10^{-8}$) determines the curvature of the universe: ${}^{R_c}/_{R_w} \approx 1.000746 \ldots$ given that $\alpha_c \approx 7.29735 \ldots \cdot 10^{-3}$. This means that the universe is very close to being flat but is not completely flat. Geometrically, the energy that ensures perfectly equilibrated universe is associated with its surface area, but surface area increases at lower rate as compared to its volume. Since the universe is restricted in space, such irreconcilability can be resolved either through a collapse or through a deliberate canalization of excess energy into nuclear fission. The latter is manifest in the way in which asymmetric fermions and symmetric bosons interact with each other: this process runs through a series of cycles via which quantum information increments in parallel with the increase of the macroscopic angular momentum ($G_c = e^{\alpha_c^{-1}}$), equivalently, the radius of the universe ($R_c = \alpha_c e^{\alpha_c^{-1}}$). Which means that formation of matter runs via a series of recursive thermal relaxations in the course of which appropriately scaled local equilibriums are sequentially settled and mechanical peaks of translational forces are sequentially localized as their underpinning quantum fluxes are twistedly reversed. Anchored to the branch point $(-e^{-1}, \mathrm{W}(-e^{-1}))$, this process is manifest in the peaks of the nuclear reaction, which can be written as follows: $\mathrm{H} \ldots \rightarrow \mathrm{C} \leftarrow \mathrm{N} \rightarrow \mathrm{O} \ldots \leftarrow \mathrm{Fe} \rightarrow \ldots \leftarrow \mathrm{Ag} \rightarrow \cdots \leftarrow \mathrm{Au} \rightarrow \cdots \leftarrow \mathrm{Tl}\ (\mathrm{P}(\mathrm{Tl}_{208}) = \mathrm{W}(e) - e^{-1} \approx 63.2\%) \leftarrow \mathrm{Bi} \rightarrow$ $\mathrm{Po}\ (\mathrm{P}(\mathrm{Po}_{212}) = |-\ e^{-1}| \approx 36.8\%) \ldots$ where $\mathrm{P}\ (\mathrm{element})$ is the probability of the element decay bracketed. Of particular interest is the bismuth twist (peak); given the construct suggested, we are able to assume that it is bismuth (Bi) that serves as a critical threshold through and via which the time-rate of the electron yields a qualitative shift in the process of nuclear formation, which is what a connection between r-process (rapid neutron capture) and s-process (slow neutron capture) essentially implies: Bi −twist terminates the slow neutron capture so that all heavy nuclei after bismuth are built via the rapid neutron capture only.

To gain a further insight into the mechanism of nuclear formation, it would be helpful to address the following recursive construct:

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

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 ω −based branches of the recursion are used for a clearer representation of the following double helix pattern:

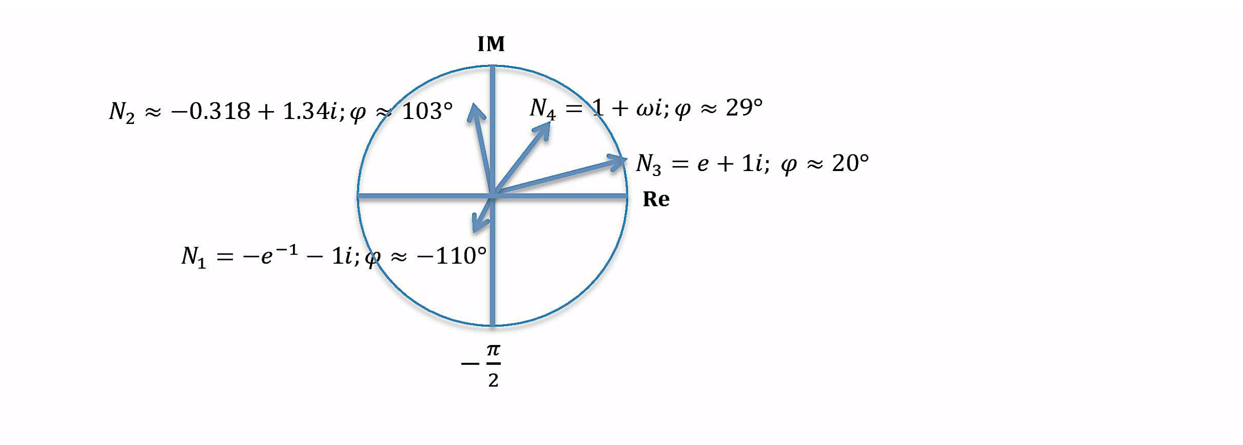

Fig. 2. The initial twist of the double helix pattern

The upper $\alpha -$ branch yields the time-rate of the proton $(\Im(N_2) = T_{proton} \cdot 10^{-1})$ and the gravitational potential of the electron $(\mathrm{mod}(N_2) = \alpha_w^{-1} \cdot 10^{-2})$; multiplying the boundary numbers of this pattern immediately yields the radius of the proton: $N_1 \cdot N_3 = (-e^{-1} - 1i) \cdot (e + 1i) = \ -(e^{-1} + e)i,$ or in terms of polar coordinates, $\rho \approx 3.09 \ldots \approx R_{proton} \cdot 10^4;\ \varphi = -\boldsymbol{\pi}/\boldsymbol{2}$ (emphasis added; to remind, R_{proton} is the point of reverse of the universal quantum vortex, as Eq. 7 describes). Thus, the pattern immediately yields the time-rate and the radius of the proton, scaled in accordance with the factor of ten (the logic of this research assumes that this factor is an arithmetic simplification of π^2, interpreted as an arc length corresponding to the central angle of $180°$ given that $r = \pi$, which is the shortest way to connect opposite quantities, implying a spatial condition of perfect physical equilibrium). Also, that pattern yields the radius of the 'dark' electron: $R_e^D = T_0 \cdot e^{T_0^{-1}} \approx 2.84 \ldots$, where $T_0 = \alpha_w^{-1} \cdot 10^{-2} \approx 1.37 = \mathrm{mod}(N_2)$, that is, the pattern describes the structure of both the ordinary and 'dark' hydrogen, which assumes that the hydrogen atom was the first shape drawn from the primordial physical void.

According to the model, R_{proton} concurs with the proton-neutron contact area, characterized by an anomalously huge gravitational steepness (Table 1). Logically, this steepness emerges in a response to an influx of free neutrons that are constantly inflating gravitational contour of the universe, implying the maximum of the mechanical pressure arising from that influx and corresponding therefore to the maximum value of the magnetic-mechanical momentum of translational forces. As the model explains, this neutron influx is sequentially compensated via a series of successive equilibriums as the whole process is consistently orchestrated by the proton-electron relationship, equivalently, by the asymmetry–symmetry parity, correlated with the magnetic-mechanical properties of atoms, as pointed out long ago by Pierre Curie. The above explains why electric and magnetic fields move at right angles: this orthogonal property is predetermined by the mutual arrangement of the time-rate of the electron and the radius of the proton (Fig. 2). Which is parallel to Brewster's law, claiming that perfect polarization occurs only if reflected and refracted influxes are set orthogonally to each other. Given such parallel, we are able to claim that perfect polarization of the incoming neutron influx should be expected at $cos\, \varphi_d = 10 \cdot T_{proton} \cdot \alpha_w = {}^{\Im(N_2)}\!/_{\mathrm{mod}(N_2)}$, which is the primordial angular displacement φ_d against the symmetry ensured by the attractor (Fig.2). Thus, individually canalized quantum information is strictly related to the bismuth twist and therefore to other elemental abundances of the periodic table, such as the iron peak, which means that all physical processes are arranged in a translation invariant fashion; that is, they are invariant under spatial rotations.

In physics, the mechanism of mass formation is addressed in terms of the standard model. According to this model, the masses of all physical particles arise from the interactions with the so called Higgs field that generates the Higgs particle; the standard model claims that this particle is a zero-spin super-massive boson that mediates with translational forces through a mass-less particle with the spin of 2. Here we should pause to remark that mass-less (and spin-less) particles do not exist in reality: either mass or its absence, but not both at once. Logically, zero-spin implies equilibrium, that is, a complete coincidence of a physical object with itself.

Such insight allows us to fully appreciate the physical meaning of the radius of the electron $R_w^{-1} \cdot R_w = 1$. Given that it is gravity that twists all translational forces together, one has no other option but to agree that the mysterious mass-less particle with the spin of 2 and the long-sought super-massive zero-spin boson are two complementary guises of the same quantity—the gravitational radius of the electron: $R_g = 2R_e = 2$ (macro-scale) while its micro-equivalent exactly equals the classical radius of the electron: $r_g \approx \frac{\hbar_w}{2} = r_e$, that is, the gravitational and classical microscopic radii of the electron concur with each other (Table 2). The physical meaning of the former relationship ($R_g = 2$) is that the macroscopic gravitational radius of the electron contains twice the physical degree of freedom of the electron, implying that the universe comprises two quantum domains, right-handed and left-handed ones. The latter relationship ($r_g = r_e$) implies that the shape of every quantum particle, in each domain, is determined in terms of gravity via the classical radius of the electron $\frac{\hbar_w}{\mathbf{2}}$, equivalently, via the quantum of action of the electron $\hbar_w = \alpha_w \cdot \omega$ or, speaking in terms of electrodynamics, via the electric charge of the electron $\pm\sqrt{2\alpha_w^2\omega}$.

Because of the fundamental chirality inherent in fermions, conventional electrons outnumber conventional positrons, which is why positrons can be conceived as the electrons that rotate in reverse; so, it is quite natural to associate positrons with the electrons that move as if backwards in time; accordingly, any physical process exists only in parallel with its chiral counterpart that evolves as if backwards in time. It is true that the electro-magnetic force has never been observed to flow backwards, but it is also true that physicists consistently distinguish between the negative and positive electric charges. Given that time is associated with counter-rotation of quantum particles, it becomes possible to appreciate why today's physical theory associates time reversal with changing the positive mass of an elementary physical particle into the negative one. Here, we have to repeat that negative masses cannot exist in reality; that is, the term 'negative mass' is physically meaningless, which is why current physics cannot explain why the universe is full of matter and lacks so called antimatter. To disentangle physics from the phantom of antimatter, we should take into consideration the modus operandi of time and gravity: time synchronizes rotation of the left- and right-handed quantum domains via gravity; gravity gives rise to mass in both domains; each domain operates on the basis of its initial handedness; as for everything else, each domain works as well as the other. Interconnected via their common causal structure, any two agents of quantum coupling have no alternative but to be in chiral opposition to each other. Both physically and mathematically, this opposition is manifest in the bi-polarity of the electric charge of the electron $\pm\sqrt{2\alpha_w^2\omega}$, which implies that a spin of any elementary physical particle is either left- or right-handed. To this, it may be added that some atoms are marked with positive (such as bromine) and some (such as lithium) with negative charge domination; different charges attract each other, which results in the formation of almost neutral molecular structures. The universe however has not so far collapsed into a state of complete sameness; quite the opposite: the energy of void does not dilute over time, because the individuated quantum information inherent in fermions is disseminated at different rates and it is time that accounts for this process, sustaining enduring existence of the universe as a whole. And perhaps it is already obvious why all three fundamental symmetries (C, particle-antiparticle interchange; P, parity reversal and T, time reversal) hold only at once: these symmetries arise from the same logical pattern via which they are synchronized to the gravitational radius of the electron, anchored, in its turn, to the physical limit of the universe.

8. Gravitating around oneness

Thus, two perfectly zeroed counter-rotating quantum domains induce each other in a deterministic manner. That is, the $-e^{-1}-$ based probability relationship holds in both the right- and left-handed quantum domains; either domain works as well as the other, but due to the initial conditions one species sooner or later become more numerous than the other, and then the more numerous species, marked with the same handedness, ineluctably become dominant in the domains of their original handedness.

All physical interactions are synchronized to each other via the macroscopic angular momentum of the electron G_w, implying multiple degrees of freedom, and its microscopic complementarity ω, implying single degree of freedom. All quantum particles are characterized by individuated quanta of action ($\propto \hbar_p = \alpha_p \cdot \omega$) that are strictly anchored to the physical limit of the universe R_w^{-1}. It is precisely the individuated values of the quantum of action that allow all physical particles to be kept apart as they pass through the attractor $R_e = 1$ that bridges differently rotating microscopic domains, which, in particular, explains why the universe unfailingly avoids the so called ultraviolet catastrophe. Of interest is that in the neighbourhood of the attractor the strength of gravity steeply increases as the time-rate of the electron decreases in the same abrupt manner (Table 1), which is why observers on the Earth have good reasons to claim that in the neighbourhood of the attractor time dramatically slows down. Since gravity permeates the whole universe, it manifests itself in our daily life. Take, for example, how it works in abnormal situation when we suffer a near-ultimate physical or psychological load; seeking to restore a disturbed equilibrium, the time-rates of the organism decrease, forcing the 'intelligent eye' to fix upon the surrounding media as a slow-motion picture—this mechanism provides our organism with a delay to make a vital decision, thus conferring an additional chance to survive: self-organization within the system intensifies, implying that time slows down as gravity increases.

There is a growing body of evidence suggesting that that modus operandi of gravity is ubiquitous in nature, underpinning all physical processes, irrespective of their particular 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 modus operandi of gravity also explains, for example, the phenomenon of so called negative pressure in trees: as if against the law according to which an 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; solar storms that are switched so that the same coronal mass ejections that heat the upper atmosphere of the Earth also trigger chemical reactions that quickly cool it… Arising via a finely synchronized cascade of repulsions and attractions of differently rotating quanta, the self-referential universe invariably alternates clockwise and counter-clockwise rotations, remaining strictly anchored to its physical limit $|R_w^{-1}| = \left(\left|\sqrt{10\omega}\right|\right)^{-1} \cdot 10^{-57} \approx 42 \cdot 10^{-59}$.

Continuous null-based mathematics makes it obvious why current physics gives us three mutually exclusive scenarios: the universe is either open and expands or close and shrinks; otherwise, it is completely flat and neither expands nor shrinks. It is only when the concept of null and that of zero are distinguished from each other that it becomes possible to piece these scenarios together; that is, the order across the universe is ensured via a combination of the future (openness), the past (closeness) and the present (flatness), implying that the symmetry of bosons and the asymmetry of fermions are mutually complemented via their connecting electron joint, the attractor of the universe $R_e = \alpha_w \cdot \alpha_w^{-1} = 1$.

The above entails that the law of physical conservation of the universe can be written compactly as follows: $(\pm R_w^{-1})^0 = 1$, implying that the zero-point energy of void is conserved via the attraction and repulsion of differently rotating spins of quantum particles around the attractor; and exactly the same can be formulated in terms of the mathematical nothing: $\ln\Omega^{-1} + \ln\Omega = 0$, where $\Omega = R_w^2$. Which reads as follows: the initial and boundary states of the universe are reciprocally squared with each other or, we may say, fundamental physical constants are perfectly tailored to square the initial and boundary states of the universe, which is what the fourth term of Eq. 2 tells us: $\ln\Omega^{-1} = -\ln\Omega$, where $\Omega = R_w^2$. In classical physics, this conservation law reveals itself via a relationship between centrifugal and Coulomb forces: $\frac{mV^2}{r} = \frac{e^2}{r^2}$. Appropriate substitutions (Table 2) yield $\frac{8}{\omega} = \frac{8}{\omega}$; this identity can be re-written as follows $\frac{8}{\omega} \cdot \frac{\omega}{8} = 1 = \frac{8}{\omega} \cdot \frac{\omega}{8}$, which aptly accentuates that mathematics is certain and it is that certainness that lies at the heart of physical knowledge. And it is perhaps already clear that it takes only one mathematical constant to describe the physical structure of the universe: the omega constant, the rest is a matter of semantics.

9. Returning to the origin

Schematically, a rotational motion of a material object, say a distinct planet, results in irreversible matter splitting, which is manifest in crystal dislocations, occurring until a single crystal loses its individuated identity and becomes a structure-less specimen. Of course, the more complex a system, the more it can resist to decomposition; the more information is actualized, the more energy can be dissipated, for example, heterogeneous forests demonstrate more ability to cool themselves as compared to homogeneous deserts, but ultimately decomposition of matter is irreversible. As time does its work, the surface of the planet becomes more uniform; as it becomes more uniform, it needs less energy to stay in equilibrium. This process occurs until all matter of the planet completely transforms into uniform radiation, implying $\alpha_c = \alpha_w$, which is what Poincaré recurrence theorem essentially claims: if entropy is increasing now it will certainly decrease in the future. Of relevance to the second law of thermodynamics is that any physical process that reduces entropy incurs thermodynamic costs; as the present research explains, it is gravity that serves this entropic debt via creating the cosmic order in advance of thermodynamic processes, and does it in an uninterrupted manner (which is why it is mathematically impossible for gravity to take the value 0: there is no x to satisfy $e^x = 0$). Thus, entropy (unbounded information) and gravity (bounded information) are bridged via time (the time rate of the electron); as long as the time-rate of the electron and its gravitational potential are reciprocally interconnected, their product remains constant, implying equilibrium ($\alpha_w \cdot \alpha_w^{-1} = 1$, where α_w is the time-rate of the electron and α_w^{-1} its gravitational potential, its free entropy). It is therefore plausible that time and gravity control entropy throughout both the aeon of ascent ($\alpha_w \longmapsto \alpha_c$) and the aeon of descent ($\alpha_w \longleftarrow \alpha_c$). The difference between the ascending and descending phases of a cosmic cycle is that in the former case entropy sustains genesis of matter while in the latter case it sustains decomposition of matter; in both cases, the rate of the incoming entropy is synchronized to gravity via time; from this, it follows that the unity of time and space $\alpha_w \cdot \alpha_w^{-1} = 1 = R_w \cdot R_w^{-1}$ holds across the whole universe, allowing the time-rate of the electron and its space-like complementarity (wave-length) to be synchronized to each other in a self-referential manner: when α_c and α_w become equal, change and stasis become one (but only in a distinct spatial enclave of the universe). That is, everything originates from and comes back the omega point, which is exactly what the concept of eternal return implies ($\alpha_w = -\mathrm{W}_{-1}^{-1}\left(-R_w^{-1}\right)$, where $R_w = |\sqrt{10 \cdot \omega}| \cdot 10^{57}$). At the moment of that ideal concurrence of time and matter ($\alpha_c = \alpha_w$), the last quantum of once living matter dissipates into nothingness where a new star and a new life are to be born, but in a new time—if the time of a distinct planet comes to end in one spatial enclave of the universe, it will certainly arise in another one, which, in particular, means that cosmos as the entire physical universe can never reach a state of ultimate stasis. Physically, it is true that time and matter systematically nullify each other, but what reconciles this annihilation with life is that life perpetuates itself via meaning and its underlying information, implying that there is no material force that is able to destroy all life in the universe: if information becomes disconnected from its material carrier, it remains connected to its underlying pre-material void, which ensures an enduring possibility for meaning to be preserved.

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