A Coherent Resonant Cosmology Approach and its Implications in Microphysics and Biophysics

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Abstract While the *reductionist* approach, best expressed in Descartes' *Method*, helped science to develop along the *objectivity* principle, the modern crisis in quantum mechanics and cosmology calls for a return to a traditional *holistic* viewpoint, where the *large* would explain the *small*. This could lead to replacing the concept of 'emergence' (where the *whole* exceeds the *parts*) by that of 'immergence' (foreseen in Mach's conjecture). This implies a temporal invariance of the cosmological parameters defined by applying the Bekenstein-Hawking holographic principle. This latter is associated with a *coherence principle* according to which any well-defined system (such as a living organism) is associated with a specific frequency, analogous to the clock of a computer. Physical laws would then be related to a computing process. This coherence principle is shown to be central in atomic physics and defines Coherent Cosmology, which can be seen as a synthesis of standard cosmology and steady-state cosmology, completed by a 'Grandcosmos' extending the observable Universe radius by a factor 10^{61} and associated with the Cosmic Microwave Background (CMB). For the observable Universe, there is a specific frequency of 10^{104} Hz, introducing a quantization of space-time 10^{61} smaller than Planck's scale. The Universe equivalent mass is expressed in terms of the main three microphysical masses: electron, proton, and hydrogen; all microphysical masses would be submultiples of it. The dimensionless 'large numbers' issued from Cosmology and Microphysics are shown to enter a Topological Axis with an emphasis for 26 dimensions, rehabilitating the Bosonic String Theory and pointing to massive gluons and superspeed signals. The Kotov non-Doppler coherent cosmic oscillation appears as an absolute clock, in holographic connection with the background. Generalized holographic conservation yields the critical condition while the trivial matter density 3/10 solves the dark energy problem. A systematic elimination of *c* helps to relate the physical parameters to Kotov's well-measured cosmic period: 9600.61(2) s, and *c*-free standard dimensional analysis confirms the invariance of the Universe horizon, matter density, and background temperature. The later appears related to the

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triple-point temperatures of H_2, O_2, and H_2O, and to mammals' temperature through Sternheimer's scale factor: $j = 8\pi^2/\ln 2$, which itself is related to the electric constant: $a \approx 137.036$. Analysis of the masses of DNA nucleotides and protein amino-acids shows a connection with Kotov's period, suggesting that DNA could be a linear hologram. The Darwinian step-by-step macroevolution theory, by unrelated random mutations and natural and sexual selection, seems then irrelevant. We have also investigated the relations between physical canonical large numbers and economic and musical numbers, hinting that the human brain may act as a multi-basis computer, favoring the universality of Intelligent Life.

Keywords Holographic principle • Steady-state cosmology • Coherent cosmology • Antimatter • Dark matter • Dark energy • Eddington theory • Combinatorial physics • Photon mass • Graviton mass • String theory • DNA • Protein • Cosmobiology

1 Introduction

There is a widespread opinion that something went wrong in contemporary standard cosmology. In a recent perspective [1] it can be read: "No one yet knows how the theoretical illnesses of cosmology will be solved, if they can be solved, or even if they need to be solved. As more conventional attempts to find solutions failed to make headway, however, it becomes tempting to try more radical ideas. As evidenced by past paradigm shifts in physics, radical ideas are often necessary for progress, and we, as a community, must be open to their exploration. Certainly, there is no point in being dogmatic about Cold Dark Matter (CDM) when there is consensus that it cannot be the full picture. Still, it should be a principled radicalism that we insist upon. Smashing the foundations of the standard cosmological model is all well and good, but the end result cannot be considered successful unless it is a truly predictive theory - one that not only fits the bulk of current and future data, but explains it as a non-trivial consequence of its deeper structure. Simply introducing additional unconstrained degrees of freedom to fit-out deviations will not do. An alternative theory should ideally strengthen the connections between cosmology and the rest of physics too, as CDM has done so ably. Theories with special constructions that disconnect the causes of cosmological phenomena from their possible consequences elsewhere look feeble. But even if evolution, rather than revolution, is needed to fix up CDM, there may still be something to recommend a more radical stance - perhaps a shake-up of our perspective, rather than our theory, is what has been needed all along".

In particular, consider the 'flatness problem', i.e., why the Horizon radius R and the Universe equivalent mass M are tied by a simple relation: $M = Rc^2/2G$. This problem is currently solved by an ad-hoc inflation step, but this introduces other theoretical difficulties [2]. Another issue is the value of the so-called dark energy density: $\Omega_\Lambda = 0.685(17)$ [3, 4]. This is compatible with the trivial value, 7/10, one obtains by combining the gravitational potential energy of a homogeneous sphere: (3/5) GM^2/R, with the above critical condition. This yields (3/10) Mc^2, letting the density 7/10 apart. This seems to indicate that cosmology may be simpler that it is ordinarily believed.

Another intriguing point concerns the Hubble constant. While a recent direct measurement involving supernovae *1a* [5] yields a value 73.8(2) km s^{-1} Mpc^{-1}, the Planck mission result [3, 4] is 67.8(9). These values are discordant but their average is very close to that tied to the so-called universe age, 13.81(5) Gyr. Such a direct correspondence is obtained in the *single time-invariant parameter* steady-state cosmology [6, 7], while the standard cosmology optimizes *six time-dependent parameters*.

The forgotten steady-state cosmology had correctly foreseen the acceleration of the galaxy recession and the critical flatness. The main argument that led to its discarding, the discovery of the Cosmic Microwave Background (CMB), was in fact not pertinent. Indeed, the steady-state cosmology is the only one that predicted correctly its temperature, from the Helium density [8]. From Oort's estimate of 10^{-30} g cm^{-3} for real matter density, and from the energy associated with each Helium atom formation, one obtains about 3 K in a single line of calculus, as shown below. By contrast, involved computations from the primordial Big Bang model, with transition from the cold to the hot Big Bang, led to temperatures between 5 and 19 K [9].

Contrary to the primordial Big Bang model, the steady-state model is highly refutable, which is a standard criterion for a theory to be scientific. Opponents to the latter proposed various arguments, which later appeared to be disputable [10]. However, it is true that the founders of the steady-state cosmology embarked in a search for a thermalizing agent such as metal or carbon whiskers [8], which were not convincing. This was the main cause for the rejection of their cosmology. But this objection also is not pertinent, because a kind of 'Grandcosmos' could play that thermalizing role, as will be explained below. So observations of CMB, which seem to confirm the standard model, could be a mere misinterpretation. It is significant that opponents concentrated their efforts on the problem of the thermal agent. The irony is that standard cosmology lead to the hypothesis of a *Multiverse* [11], which is unobservable, while a 'Grandcosmos' could be manifested by the CMB.

A delicate point in the steady-state cosmology is that, as a consequence of its basic assumption, the *Perfect Cosmological Principle,* new matter must appear to compensate for the galaxy recession. This has been seen as a violation of energy conservation. But it is not really so, since *in an invariant horizon the energy must remains invariant*. It is true that this new matter rate production is too tiny to be directly measurable. But it implies a coherence of the whole universe, implying a tachyonic physics [12] tied to quantum non-locality and, eventually, a discrete and deterministic physics [13]. A new matter apparition could be related to the strange observations reported by Arp [14].

Another dramatic observation is the non-Doppler oscillation [15], with a period $t_{cc} \approx 9600.61$ s, observed in several quasars since decades by Kotov and Lyuty. It will be shown that this is directly related to the gravitational and Fermi constants

G and G_F. So, steady-state cosmology, a highly refutable model, not only has not been refuted, but has shown to be very predictive.

There seems to be a serious objection against the steady-state model: for a given observer A, the celerity of a galaxy can exceed c when it passes across the horizon of A, while for another observer B this is not so, since the horizons A and B are different. This will be discussed in Sect. 9, where it will be assumed there is an absolute clock related to a CMB absolute space (or preferred Galilean frame).

Now, what is the meaning of the expression: 'Expanding Universe'? If one defines the Universe as the totality of everything, it is a contradiction since one cannot answer the question: 'In what is the Universe expanding?' But with the assumption of a Grand-cosmos, the situation is clearer. However, since the horizon radius is time-invariant the term 'expansion' should be replaced by 'galactic recession'. Indeed, assuming a repulsive force between two galaxies of masses m_1 and m_2 proportional to their distance l, its simplest expression is: $\sqrt{(m_1 m_2)}\ l/T^2$, where $T = R/c$ is the only free parameter in the steady-state model. This force corresponds to an exponential recession, and exceeds the gravitational force for a distance superior to $(\sqrt{(m_1 m_2)} GT^2)^{1/3}$: this is of the order of 10^6 light years, the dimension of a galaxy group. Neglecting this simple argument led to a historical misconception: Lemaître and Hubble had taken into account galaxies belonging to the Local Group, and their value of the corresponding 'Hubble constant' was underestimated by an order of magnitude. Actually, the diagram shown by Hubble was anything but a straight line and was supported by a single distant galaxy studied by Humason, his assistant at Mount Wilson observatory [8].

There remains to explain the large success of the standard, primordial Big Bang theory, called 'Λ-CDM concordance model', with a cold 'dark matter' (CDM) and a repulsive 'dark energy' tied to the so-called cosmological 'constant' Λ. In this paper we show that the two cosmologies are mutually compatible if one replaces the primordial Big-Bang phenomenon by a very fast cosmic oscillation. We first proposed this model in 2011 [16] and here we develop its implications in microphysics and in biophysics.

Section 2 is a quick reappraisal of the cosmology foundations, suggesting a model of *ultrafast computing Cosmos*, implying Diophantine physical laws.

Section 3 recalls basic c-free definitions, with proposals for the horizon radius R and cosmic oscillation period t_{cc}. This shows a dramatic symmetry between *Newton and Fermi constants*, related to the parity violation.

Section 4 is devoted to a coherence analysis of the Universe, showing that the critical condition is a mere application of the standard holography principle and leading to the *replacement of the standard inflation by a very fast oscillation*. This is tied to a quantization of length-time and under-quantization of mass, related to the vacuum energy. This latter is known to be 10^{122} larger than the visible energy, the largest discrepancy in theoretical physics.

Section 5 presents a 'Black Atom' model revealing the *tight connections between micro- and macro-physics*, related to properties of the electric coefficient $a \approx 137.036$.

Section 6 is devoted to *holographic two-step interaction*, leading to a proposal for photon and graviton masses with a gravity speed C_g exceeding c by $\approx 2.47 \times 10^{36}$.

Section 7 presents an approach of cosmology from the *point of view of a quantum system*, with a model of '*gravitational* H_2' pointing to an understanding of dark matter.

Section 8 is devoted to the *combinatorial hierarchy*, suggesting that the physical parameter values are not due to chance, contradicting the *Multiverse* hypothesis.

Section 9 shows special holographic relations, merging into a *topological axis*, this rehabilitating ultrafast bosonic string theory.

Section 10 is an introduction to *Cosmobiology*, showing that significant combinations of masses of nucleotide bases and amino-acids are related to 'magic numbers' occurring in cosmology and microphysics.

Section 11 presents the *Harmonic Principle*, confirming that fundamental laws are arithmetical in nature.

A conclusion summarizes the misconceptions that have led to the present blockage of theoretical physics and cosmology, and recalls general principles to be used in the search for a Diophantian Grand Theory.

2 A Reappraisal of Cosmology Foundations: Coherence Principle

In this paragraph, we discuss the usual reductionist approach of the Universe as an ensemble of elementary particles in statistical c-limited interactions, tied by differential equations.

According to Poincaré, the laws of physics must be invariant, a premonition of our Perfect Cosmological Principle, which adds to space homogeneity time regularity, the basis of steady-state cosmology.

More generally, the very concept of physical law implies a calculus behind it. This is in contradiction with the usual statistical interpretation of quantum physics, but will be confirmed by 'coherence analysis' (Sect. 4). Note that Poincaré was first to stress that the hypothesis of quanta is the only one that can lead to the Planck law [17]. Later on, this specialist in differential equations claimed that physics can no longer be founded solely on differential equations [18].

There are two kinds of laws: local and global. The first laws are of differential type and sensitive to boundary or initial conditions. Thus they cannot be applied consistently to cosmology, for the observable Universe is unique and, as Poincaré first noticed, free parameters would be involved [18]. The second type is that of conservation laws, with no free parameters: for instance, energy conservation in a closed system, a phenomenon that is not really understood from its classical association with a homogeneous time. But if one introduces a *coherence principle*, stating that a 'well-defined' system is vibrating with an invariant frequency f (for instance, a matter-antimatter vibration [16, 19]), then the meaning of energy conservation is that energy is associated with frequency, a more basic concept. Now, an invariant frequency is an essential requirement in holography. This technique is the most efficient way to deal with information and it can be shown to correspond to global conservation laws.

Interestingly, independently of the present 'Coherence Principle' and of the earlier arithmetic 'Holic Principle' [19], other physicists introduced a reduced 'Holographic Principle' [20], generally limited to the consideration of a single holographic unit: the Planck area. But we have shown [21, 22] that other units, especially *the linear Planck length* as well as fundamental particle and cosmic wavelengths, enter such holographic conservation relations.

But the essential point for applying holography has been overlooked: holography needs complete coherence of all waves, meaning a single frequency at work, and this is not possible if the Universe is limited by *c*, far too slow to insure coherence in the Universe.

In addition, the so-called 'wave-particle dualism' has never been really explained. The experimental fact is that *matter, as light, propagates by waves but is absorbed by quanta*. The simplest explanation is that rapid precursors 'analyze the situation' before the quantum effect takes place [23]. Non-locality is thus essential in wave mechanics. One cannot understand quantum physics without involving a superspeed cosmology. One of the goals of the present article is to compute this celerity.

3 The Fundamental Formula: Evidence for Ultrafast Sweeping

In some of the following definitions, *c* is eliminated. Here, $a \equiv \hbar c/q_e^2 \approx 137.036$ is the inverse fine-structure constant and $\lambda\!\!\!^{-}_e \equiv \hbar/m_e c \equiv ct_e$ is the reduced electron Compton wavelength. Moreover, a_G and a_w are the gravitational and electroweak analogs of a in the famous article of Carr and Rees [11], except that these authors choose the gravitational force between two protons while we consider the force between a proton and a hydrogen atom, which will be justified in our gravitational hydrogen molecule model (Sect. 7). If M and R designate the equivalent mass and radius of the Universe, and $r_H^{(0)}$ is the bare Bohr radius and m_P the Planck mass, one defines:

$$r_H^{(0)} \equiv a\lambda\!\!\!^{-}_e \tag{3.1}$$

$$a_G \equiv \hbar c / G m_p m_H \tag{3.2}$$

$$R/2 \equiv a_G \lambda_e \tag{3.3}$$

$$m_P^4 \equiv M m_e m_p m_H \tag{3.4}$$

$$a_w \equiv \lambda_e^2 \hbar c/G_F \tag{3.5}$$

$$t_{cc} \equiv \sqrt{(a_G a_w)}t_e \tag{3.6}$$

The elimination of *c* is what is expected in a Coherent Universe, for this speed is clearly too small to connect such a vast space. For this reason, in order to explain the homogeneity of CMB, the standard cosmology invokes an *ad-hoc* superfast inflation. It is of course more logical to invoke quantum non-locality. Interestingly, the associated time *R*/*c* is exactly, apart a factor 2 that is explained below, the so-called Universe age. We predicted it, 18 years before its recent 0.3% determination, by using *c*-free dimensional analysis and the symmetrical product of electron-proton-neutron masses. The reason why this simple calculation was not made earlier is probably because the common setting $c = 1$ in formulas excluded *c*-free dimensional analysis. Note that the identification of the concepts of space and time was earlier criticized by Poincaré [18]. However, this 0.3% correlation also means there is something right in standard cosmology, which has to be taken into account in other models.

Since the Fermi constant G_F, the associated Fermi mass: $m_F \approx 573\ 007.33(25)$ m_e, and the cosmic period t_{cc} are 100 times better defined than G, we have derived a more accurate value of G, G' (Table 1), whose tabulated value [3] was an average between widely spread measurements. The corresponding value for R is:

$$R \equiv 2G_F t_{cc}^2/m_e \lambda_e^4 \equiv 2\hbar^2/G' m_e m_p m_H \approx 13.8123 \text{ Gly} \tag{3.7}$$

corresponding respectively to $\hbar$-free and *c*-free definitions.

Combined with the critical condition, this corresponds to the following symmetric relation, solving the 'Large Number Problem' and making very precise the well-known fact [11] that a_G is of order *of* W^8, W and Z being masses of the weak bosons relative to that of the electron:

$$R/2\lambda_H \equiv \sqrt{(M/m'_e)} \equiv \hbar c/G m_e m_p \approx (WZ)^4/2 \approx \sqrt{(10/\pi_{Pt})} \times 2^{137} \tag{3.8}$$

Note that this corresponds to a special case of Eddington's formula [24]: $R/2\sigma = \sqrt{N}$, with the identifications: $\sigma \equiv \lambda_H$ and $N \equiv M/m_e$, $m'_e \equiv m_e m_p/(m_p + m_e)$ being the reduced electron mass. This could mean that the electron is a basic stuff of the Universe. One may notice that the Ptolemaic approximation: $\pi_{Pt} \approx 2 + 137/120$, appears in Eq. (3.8). This yields the more accurate value G':

Table 1 Some physical constants and particle properties

Name	Symbol	Formula	Dimension	Value	Unit
Gravitational constant (experimental)	G	$F_{gr} = Gmm'/d^2$	$M^{-1}L^3T^{-2}$	$6.6738(8) \times 10^{-11}$	$N\ m^2\ kg^{-2}$
Gravitational constant (optimized)	G'	*idem*	*idem*	6.67546×10^{-11}	*idem*
Light velocity	c	Constant in all inertial frames	LT^{-1}	299 792 458	$m\ s^{-1}$
Reduced Planck constant	$\hbar = h/2\pi$	$E = \hbar\omega$	ML^2T^{-1}	$1.05457173(5) \times 10^{-34}$	J s
Electron rest mass	m_e	Negative for positrons	M	$9.1093829(4) \times 10^{-31}$	kg
Electrical constant	$a = \alpha^{-1}$	$F_{el} = \hbar c/ad^2$	Dimensionless	137.03599907(4)	Pure number
Fermi constant	G_F	$\hbar^3/cm_F^2$	ML^5T^{-2}	$1.4358509(7) \times 10^{-62}$	$J\ m^3$
Gravitational Sanchez const.	a_G	$\hbar c/Gm_p m_H$	Dimensionless	$1.6919335 \times 10^{+38}$	Pure number
Classical electron radius	r_e	$\hbar/am_e c$	L	$2.8179403 \times 10^{-15}$	m
Compton electron radius	$\lambda\!\!\!^{-}_e$	$\hbar/m_e c$	L	$3.8615926 \times 10^{-13}$	m
Bare Hydrogen Bohr radius	$r_B^{(0)}$	$a\hbar/m_e c$	L	5.291772×10^{-11}	m
Hydrogen-electron mass ratio	H	m_H/m_e	Dimensionless	1837.152645	Pure number
Proton-electron mass ratio	p	m_p/m_e	Dimensionless	1836.152672	Pure number
Neutron-electron mass ratio	n	m_n/m_e	Dimensionless	1838.683659	Pure number

$$G' \approx 6.6754552 \times 10^{-11}\,\mathrm{kg}^{-1}\,\mathrm{m}^3\,\mathrm{s}^{-2} \quad (3.9)$$

This value is consistent with the relation: $p_G = m_P/2^{63.5} m_e \approx 2^{12}/\sqrt{5}$ (accurate to <140 ppm), implying a role of the Babylonian value: $\pi_{Bb} \approx 25/8$. Indeed, a systematic search on the computer reveals the following (10^{-9} accurate) relation, where H, p and n are the mass ratios of the hydrogen, proton and neutron to the electron (Table 1):

$$\pi_{Pt}/\pi_{Bb} \approx 6\pi^5 pH^9/p_G^4 n^7 \quad (3.10)$$

The above definitions also imply the relation:

$$\sqrt{(G'G_F)} \equiv (\lambda_e^{\,2}/t_{cc})\,\hbar/\sqrt{(m_p m_H)}, \quad (3.11)$$

showing two terms that are *both area speeds*, characteristic of the second Kepler law. This is significant of a sweeping construction-deconstruction of the Universe through a single point (that we called 'Hol' [19]), corresponding to *zero-dimension holography*. Since such a sweep is necessarily oriented this may be the source of right-left dissymmetry, called 'parity violation' in particle physics and 'chirality' in biophysics.

Note that the common belief that quantum physics is limited to the microphysics is false, since the Pauli exclusion principle also enters the calculation of a star radius via the concept of energy degeneracy. Also, if all atoms in a star are identical, a question is the limit of the star radius when the number of atoms goes to unity. The following calculation of a star radius was given by Davies [25].

A ball of gas of radius R remains in equilibrium if its self-gravity is balanced by the combined effect of its internal thermal pressure and its electron degeneracy pressure. This is the case if the gravitational energy per particle is comparable to the sum of the thermal and degeneracy energies. For a hydrogen gas this implies:

$$k\theta + N^{2/3}\hbar^2/m_e R^2 \sim GMm_p/R \quad (3.12)$$

with $N = M/m_p$. At low density (large R), the second term is small, and the temperature θ is then inversely proportional to R. This is the case when the star starts forming from a slowly contracting cloud of gas. Eventually, when the radius shrinks, the degeneracy term becomes important, and the temperature reaches a maximum when:

$$Gm_p^2 N/R \sim N^{2/3}\hbar^2/m_e R^2 \quad (3.13)$$

is largest. This occurs for:

$$R \sim 2\hbar^2/Gm_p^2 m_e N^{1/3} \quad (3.14)$$

which is, for N going to unity, the above redshift radius (3.3), except for a hydrogen/proton mass ratio.

It is recalled that Eddington's prediction [24] for the number of hydrogen atoms in the Universe is 136×2^{256}, a prediction that is consistent with the concordance value: $T \approx 13.80(5)$ Gy. Taking account of the 3/10 relative density for matter, this writes:

$$M_{mat}/m_H = (3/10)Tc^3/2Gm_H \approx 2^{256} \times 136.2(5) \quad (3.15)$$

The accuracy reaches 20 ppm if one uses G' and the neutron mass instead of Eddington's m_H So, *dark matter would in fact be similar to ordinary matter*. But as these two varieties of matter are not photon-interacting, it would mean they are vibrating in quadrature. In Sect. 7 we relate this conjecture to a similar one for antimatter.

4 Coherence Analysis: A Computing Cosmos

4.1 The General Coherence Condition

Various authors have advanced the hypothesis that the laws of physics result from a calculation process [26]. This is sustained by the properties of cellular automates [27]. Moreover, Gerard't Hooft has shown that quantum field theory can be adapted to deal with a deterministic cellular automaton [28]. This suggests that behind the so-called 'indeterminacy' of quantum physics a 'deterministic' process is at work. This induces the following 'coherence analysis', where numerical coefficients are first omitted for simplicity.

Consider a critical Universe with radius horizon R. Filling the interior sphere with observers of virtual mass m (remember the vacuum is not really empty), this forms a volume referential superseding the ordinary three-axis frame. We define a 'coherence domain' associated to the mass m as: $\lambda_m \equiv \hbar/cm$. The total mass is limited by the critical condition $M = Rc^2/2G$, so the number N_{obs} of observers is limited to the value $R\lambda_m/2l_P^2$. Note that this critical condition currently applies to a black hole, and is considered as a limitation for preventing collapse. This formula also applies to the Universe but for the latter, *galaxy recession prevents such a collapse*. Calling d the mean distance between observers, the number of observers is:

$$N_{obs} \sim (R/d)^3, \quad (4.1)$$

yielding:

$$(Rl_P)^2 \sim \lambda\!\!\!^{-}_m d^3. \tag{4.2}$$

This General Condition will be applied in four different ways.

4.2 The Global Coherence Condition and the Large Number Problem

With the global coherence condition $\lambda\!\!\!^{-}_m \sim R$, one gets $N_{obs} \sim (R/l_P)^2$ and:

$$d \sim \left(Rl_p^2\right)^{1/3} \sim 10^{-15}\,\mathrm{m}, \tag{4.3}$$

a result also obtained by Ng [29] considering the Universe as a 'grand parallel computer' while maintaining c-limitation. In contrast, we consider a coherent and sequential superspeed Universe. The length 10^{-15} m obtained has no significance in the standard R-variable scheme, but it is close to both the nuclear scale and classical electron radius r_e. This could be at the origin of the 'Large Number Hint', considered as a problem in the frame of the variability of R, hence the so-called 'Anthropic Principle' [11]. Note that the radius r_e^3/l_P^2 corresponds to the elimination of c between r_e and l_P. Moreover, it writes as a function of the Nambu mass: $m_N = am_e$, which plays a central role in particle physics [30]. We then introduce the following radius:

$$R' = 2\hbar^2/\mathrm{G}m_N^3, \tag{4.4}$$

the factor 2 coming from the fact that the associated critical mass is then very simple: $M' = m_P{}^4/m_N{}^3$. The radius R' is slightly larger than R:

$$R'/R = m_e m_p m_H/m_N^3 \approx 1.31084. \tag{4.5}$$

The simplest interpretation is to view R' as a holographic equivalent of a *Grandcosmos* beyond, as detailed below. This ratio being close to 4/3, we can assume the following half-sphere holographic quasi-conservation of the Bekenstein-Hawking entropy [20]:

$$S_{BH} = \pi(R/l_P)^2 \approx (2\pi/3)(R/r_e)^3. \tag{4.6}$$

4.3 The Single-Observer Condition: Critical Condition, General Quantization and Universe Size

With $N_{obs} \sim 1$, or the condition $d \sim R$, one obtains:

$$\lambda_m = \lambda_M = \hbar/cM = 2l_P^2/R \sim 10^{-95}\,\text{m}. \tag{4.7}$$

This can be seen as a 'Universe wavelength', of central importance since it enters the following *holographic form of the critical condition,* $R = 2GM/c^2$:

$$\pi(R/l_P)^2 = 2\pi R/\lambda_M. \tag{4.8}$$

It is to be noted that this goes beyond the standard limitation of length by the Planck unit l_P while the standard holographic principle [20] involves only the area l_P^2.

If one considers that any particle mass $m = M/N_m$ is a sub-multiple of the total Universe mass M then the associated wavelength λ_m is a whole multiple N_m of λ_M, which allows extending the above holographic conservation in the following manner:

$$S_{BH} = \pi(R/l_P)^2 = 2\pi R/\lambda_M = 2\pi N_m R/\lambda_m. \tag{4.9}$$

This set of circles generates the approximation of a sphere. But for this approach to be acceptable the N_m must be large numbers. So the considerable vastness of the Universe receives a justification better than the standard one, which states that the initial Big Bang conditions were adjusted to 10^{-60} or so.

Note that the characteristic mass $m_0 = \hbar/Rc \approx 2.69 \times 10^{-69}$ kg is not a quantum, but a sub-quantum: $m_0 = M/N_0$, of the total mass M, with $N_0 = (R/l_P)^2/2$. This provides an interpretation of the standard Bekenstein-Hawking entropy [20] apart for a factor $\pi/2$. This is sustained by the 2% accurate formula (on a number of the order 10^{61}):

$$\sqrt{S_{BH}} = (\pi/2)\,^\wedge\,(F/\sqrt{pn}), \tag{4.10}$$

where the exponent is the Fermi mass relative to the mean proton-neutron mass.

4.4 The Standard Coherence Condition: Grandcosmos and Vacuum Energy

In standard physics, the lower limit to a spatial dimension is the Planck length l_P. With the condition $d \sim l_P$, one obtains:

$$\lambda_m \sim R^2/l_P \sim 10^{87}\,\text{m} \sim R_{GC} \tag{4.11}$$

This defines a length of the order of a *Grandcosmos* radius defined as follows. Applying the monochromatic holographic principle to the above sphere of radius R', with l_P being the monochrome unit:

$$\pi(R'/l_P)^2 = 2\pi R_{GC}/l_P, \quad (4.12)$$

we define a radius: $R_{GC} = R'^2/2l_P \approx 6.945 \times 10^{60} R$.

Assuming this 'Grandcosmos' is closed by a critical condition with superspeed C, the uniformity of equivalent matter density in the Universe implies: $C/c = R_{GC}/R$. So a mass m is associated with two energies, the standard one mc^2 and the superspeed one mC^2, with a ratio $(C/c)^2 \sim 10^{122}$. This may be a solution to a main problem in contemporary physics: the vacuum energy, which shows up in the Casimir effect [31, 32] but is 10^{122} larger than the visible energy. The expression of the 'Grandcosmos' volume in terms of the Bohr radius takes the form:

$$(4\pi/3)(R_{GC}/r_H)^3 \approx a^a/\pi \;\; approx\, (1/ln2)^{\sqrt{(\mathrm{pH})}}. \quad (4.13)$$

A simple hypothesis is that the 'Grandcosmos' is the source of the cosmic microwave background. Indeed, R' appears to be linked to the Wien CMB wavelength, for one has (within 0.1%):

$$4\pi(R'/l_{Wien})^2 \approx e^a. \quad (4.14)$$

This casts a doubt on the general belief that a thermal field looses information.

4.5 *The Field Coherence Condition: CMB and Biology*

With the field coherence condition: $\lambda_m \sim d$, one obtains:

$$\lambda_m \sim d \sim (Rl_P)^{1/2} \sim 10^{-4}\,\mathrm{m}, \quad (4.15)$$

which is of the order of the CMB wavelength, but with a significant departure that will be interpreted in connection with the identification of specific cosmic parameters with biological parameters (Sect. 10). This means that:

$$N_{obs} \sim (R/l_P)^{3/2} \sim (\lambda_m/l_P)^3, \quad (4.16)$$

showing another generalization of the standard holographic principle, since now the volume of the redshift sphere (in Planck length unit) is involved.

5 The 'Black Atom' Model

The 'black atom' model [16] considers a hydrogen atom immersed in a black hole of radius R_{ba}, limiting electron circular trajectories. The intermediate space is paved with spheres of radius $r_n = n\lambda\!\!\!^{-}$, where $\lambda\!\!\!^{-} = \hbar/m_e c$ and n is an integer. The corresponding electron velocities are derived from $\hbar = m_e r_n v_n$, this implying $v_n = c/n$ (the first trajectory: $n = 1$, is excluded). Equating the corrected Bohr radius: $r_H = a\lambda\!\!\!^{-}\ (1 + 1/p)$—where p is the proton to electron mass ratio—with the mean radius of the spheres—limited by R_{ba}/λ_e—each with a probability proportional to n^{-2}, one obtains:

$$r_H/\lambda\!\!\!^{-}_e = \Sigma(1/n)/\Sigma(1/n^2). \qquad (5.1)$$

With $z \approx 0.422784335$ (the complement to 1 of Euler's constant), this defines a radius:

$$R_{ba} = \lambda\!\!\!^{-}_e \exp\,[(\pi^2/6 - 1)\ r_H/\lambda\!\!\!^{-}_e + z] \approx 1.4923 \times 10^{26}\,\text{m} \approx 15.775\ \text{Gly}. \qquad (5.2)$$

This is very close to the value of $2\hbar^2/G\ [(ad_e + 2\pi)m_e]^3$, d_e being the abnormal electron magnetic coefficient: $d_e \approx 1.001159652$. The number $a + 2\pi$ is very close to the canonical term of the Planck law: $e^{\omega} \approx 143.3249$, where $\omega = 5(1 - e^{-\omega})$ is the Wien coefficient, i.e. the ratio between the nominal wavelength $hc/k\theta$ and the Wien length. The proximity with $a + 2\pi$ suggests that a is an a angle. Indeed (within 22 ppm), $\cos a \approx 1/e$. Now, a characteristic property (within 1 ppm) is:

$$(ad_\varepsilon + 2\pi)^3 \approx a^{3/2} m_n^2/m_e m_p, \qquad (5.3)$$

where the neutron and proton masses appear. So there is a relation between R_{ba}, R' and R, specifying the approximation (within 0.25%): $R_{ba} \approx (RR')^{1/2}$. This 'black atom' relation can be approximated by:

$$a/ln(2a_G) \approx (\pi^2/6 - 1)^{-1}, \qquad (5.4)$$

which specifies the earlier proposed rough relation: $a \sim ln(a_G)$ [11].

6 Holographic Two-Step Interaction

As conjectured at the end of Sect. 2, ultrafast wave precursors analyze the situation before 'deciding' where a quantum effect will arise [22]. It is to be noted that even the electromagnetic interaction is not yet really understood [33]. Consider, for simplicity, two identical systems of mass m in their ground state. The first system is characterized by a stationary wave which may be seen as the sum of diverging and converging waves: $s + s^*$, with $s = \exp\ [2\pi i f \cdot (t - r/c)]$, where f is the proper angular frequency: $mc^2/\hbar$. The second system is characterized by an analogous standing wave: $r + r^*$. Assuming that the vacuum is *not* empty, an hologram is formed: $(s + s^*)\ (r + r^*)$, which includes the *resonant* sum: $sr^* + s^*r$. So, the very presence of two systems creates an inhomogeneity in space.

Now, if the first system has an excess of energy, it means it is receiving an excess signal of a form proportional to s^*. By diffraction on the above hologram, it gives rise to: $s^*(sr^* + s^*r)$, with a resonant term r^*. Note the similarity between this holographic formalism and the unitary matrices of quantum physics: $ss^* = 1$. But the above argument shows that *convergent waves are of primordial importance, rather than the current diverging waves*. As the process is symmetrical, this leads to an oscillation. This is known as the particle exchange (implying a boson with mass m_B) associated with any interaction. But here it is assumed that the boson has a superspeed C_B. The resonance condition is that the wavelengths are identical, in analogy with Gabor's holographic microscopy condition [34]. So, for the electron:

$$\lambda_e = \hbar/m_e c = \hbar/m_B C_B. \tag{6.1}$$

In accordance with the previously discussed importance of R/r_H, one may try:

$$R/r_H = C_B/\mathrm{c} = m_e/m_B \approx 2.47 \times 10^{36}. \tag{6.2}$$

This could define a gravitational speed, associated with a graviton mass:

$$m_{gr} = m_e r_H/R = a m_0 \approx 3.689 \times 10^{-67}\ \mathrm{kg}, \tag{6.3}$$

where $m_0 = \hbar/Rc \approx 2.69 \times 10^{-69}$ kg is a Universe 'quantic mass' (not quantum of mass), much smaller than the Planck mass.

By extending the argument to the electroweak interaction, with characteristic mass $m_w = a_w m_e$, one may write:

$$R/r_H = C_B/\mathrm{c} = m_w/m_B' \approx 2.47 \times 10^{36}. \tag{6.4}$$

This would define a photon mass:

$$m_{ph} = m_w r_H/R \approx 1.211 \times 10^{-55}\mathrm{kg} \approx m_Z m_e/2^{24} m_P, \tag{6.5}$$

thus relating (within 90 ppm) to the mass of the Z neutral weak boson, which is known to be linked to the photon in electroweak theory. This value is much larger than that assessed by Maruani [35]: $m_{ph} \approx 1.355 \times 10^{-67}$ kg. But it is very close to that proposed by Marchal in terms of the 'cosmic oscillation' period $t_{cc} \approx 9600.60$ s [36]:

$$m_{ph} = \hbar/c^2 t_{cc} \sim 1.222 \times 10^{-55}\mathrm{kg}. \tag{6.6}$$

The present-day [3, 33] *maximal* assessed value for m_{ph} is 1.8×10^{-54} kg.

7 The Universe as a Quantum System

7.1 The Basic Hydrogen Spectrum

Three years before Niels Bohr, Arthur Haas had equalized three forms of energy: the kinetic, the potential, and the quantum *nhf* using the frequency of the electron rotation: $nhv_e/2\pi r = n\hbar v_e/r$, in a 2D circular model of an electron orbiting around a proton with speed v_e on a circle of radius r [37]. In fact, from the virial theorem twice the kinetic energy ought to be considered. Neglecting first the equivalent mass correction in this two-body system, one obtains:

$$m_e v_e^2 = \hbar c/ar = n\hbar \mathrm{v}/r_n. \tag{7.1}$$

Here, $a \approx 137.036$ is directly involved in the electric force between two elementary charges: $(q_e/r)^2 = \hbar c/ar^2$, yielding $a = \hbar c/q_e^2$ (the inverse αv_e of a is commonly called 'fine-structure constant'). Note that the so-called 'electric vacuum permittivity' and 'electric charge unit' are misleading concepts: indeed, as any electric force is a whole multiple of this unitary force, the choice of a specific unit for the electric charge is not necessary. Any electric charge is related *to a whole quantum number*.

The above relations contain the Bohr quantum relation $n\hbar = r_n m_e v_e$, yielding:

$$v_{en} = c/an, \tag{7.2}$$

$$r_n^{(0)} = n^2 a\hbar/cm_e \equiv n^2 a\lambda\!\!\!^{-}_e. \tag{7.3}$$

In fact, Haas was the first to apply what we call here the 'Coherence Principle' but, using the true kinetic energy, he obtained twice the correct value for r_n, and especially for the bare Bohr radius: $r_1 = r_H^{(0)} = a\lambda\!\!\!^{-}$. Note that with the mass correction, the real Bohr radius is: $r_H = r_H^{(0)} \times (1 + \mathrm{m}_e/\mathrm{m}_p) \approx r_H^{(0)} \times (H/p)$, p and H being the proton and hydrogen masses by respect to the electron mass.

7.2 The Gravitational 'Hydrogen Molecule'

Now, neglecting the electrostatic and exchange interactions, consider a proton coupled to a hydrogen molecule orbiting by gravitation on a circle of *invariant radius* R, where an electron is also circulating with velocity v_e. The gravitational potential energy can be written: $Gm_Hm_p/2R$, but it can be written in the same form as above by introducing the gravitational interaction constant $a_G = \hbar c/\mathrm{G}m_H m_p$. In this three-body system, the Coherence Principle gives, for $n = 1$:

$$v_e = c/2a_G, \tag{7.4}$$

$$R = 2a_G \lambda\!\!\!^{-}_{\mathrm{e}} = 2\hbar^2/Gm_{\mathrm{e}}m_{\mathrm{H}}m_{\mathrm{p}} \approx 13.812 \text{ Gly}, \tag{7.5}$$

which shows that the above definition is compatible with the 3-ppt accurate so-called Universe age: 13.81(5) Gy [4, 5].

By adding the standard critical condition or, equivalently, the Schwarzschild radius formula of a black hole horizon: $R = 2GM/c^2$, this can be written, using the reduced mass $m_e' = m_e m_p/(m_p + m_e)$:

$$R/2\lambda\!\!\!^{-}_H = \sqrt{(M/m_e')} = \hbar c/Gm_{\mathrm{e}}m_{\mathrm{p}}, \tag{7.6}$$

which is, as recalled above, Eddington's statistical formula [24]: $R/2\sigma = \sqrt{(M/m)}$, with the identifications: $\sigma = \lambda\!\!\!^{-}_{\mathrm{H}} \equiv \hbar/m_{\mathrm{H}}c$ and $m = m_e'$.

This responds to Carr and Rees questioning [11], who stated that current physics cannot explain the *Large Number Correlation*. Note that Eddington did not recognize this very symmetric identification because, at his epoch, the Hubble radius was under-estimated by an order of magnitude. It can be recalled that Eddington's basic argument was that in a black hole of radius R, the position of a particle is uncertain by a length $R/2$. If one has N particles, this is reduced by a statistical factor $\sqrt{N}$, yielding a reduced length $R/2\sqrt{N}$ which Eddington associated with the nuclear force range. But the above equation shows that it is rather the reduced H wavelength. The surprise comes from N, an equivalent number of electrons, as if everything in the Universe would be defined by electrons or if a single sweeping electron-positron pair would define it all.

7.3 Quantum Universe and Real Matter

The previous Section was limited to the case: $n = m_e R v_e/\hbar = 1$, and yielded the radius of the observable Universe. This suggests the existence of an external *Grandcosmos*, for larger values of n. We now assume that a single equivalent electron is associated with a celerity V_e obeying the Coherence Principle applied to the energy Mc^2:

$$m_e V_e^2 = Mc^2. \tag{7.7}$$

The question is: 'What is the corresponding quantum number $n = m_e RV_e/\hbar$'? This can be written, taking into account the above Eddington statistical relation:

$$(n\hbar/m_e R)^2 = c^2 M/m_e = (c^2 n\hbar/Gm_e m_p)^2, \tag{7.8}$$

which shows a symmetry (m, $-m$) expressing the *double solution matter-antimatter*:

$$n\hbar/m_e R = \pm \hbar c^2/Gm_e m_p. \tag{7.9}$$

Limiting to positive values, this leads to:

$$n = Rc^2/Gm_H = 2M/m_H, \tag{7.10}$$

which is the overall number of particles (electrons + protons) in a sphere of radius R, and a natural quantum number previously used by Eddington [24]. This is a validation of the Coherence Principle, for which an equipartition of the energy $m_e V_e^2$ among the M/m_H electrons leads to an elementary kinetic term: $m_e v_e^2 = m_H c^2$, this implying:

$$v_e = c\sqrt{(m_H/m_e)}. \tag{7.11}$$

As this is not allowed by Relativity theory and as the liberation velocity at the periphery of a black hole is c, one would rather have there: $v_e \approx c$, i.e.:

$$m_H V_e^{(\mathrm{r})2} \approx Mc^2, \tag{7.12}$$

showing the way the above model can be adjusted. So, consider a reduced number of *real* hydrogen atoms with density $\Omega_{\mathrm{H}}^{(\mathrm{r})}$. The corresponding quantum number is: $n^{(r)} = 2\Omega_H^{(r)} M/m_H = m_e RV_e/\hbar$, corresponding to: $V_e = 2\Omega_H^{(r)} M\hbar/Rm_e m_H$; then the kinetic term becomes:

$$m_e V_e^2 = \Omega_{\mathrm{H}}^{(\mathrm{r})\,2} Mc^2. \tag{7.13}$$

In order to satisfy Eq. (7.12), one has:

$$\Omega_{\mathrm{H}}^{(\mathrm{r})} \approx \sqrt{(m_e/m_H)} \approx 0.0233. \tag{7.14}$$

So, the apparently strange fact that the Universe is only scarcely occupied by ordinary matter would come from the large proton to electron ratio. Note that the above density is about half the standard baryonic density [3], but confirms the steady-state cosmology (SSC) model. Indeed, the SSC model does predict a thermal background, resulting from thermalization of stellar radiation. Taking for the helium mass density the standard value 0.252, this means a total helium mass of ≈ $0.252 \times 0.0233 \times M \approx 5.172 \times 10^{50}$ kg, or 7.726×10^{76} helium atoms. For each helium atom, the released energy is $(4m_H - m_{He})c^2 \approx 4.283 \times 10^{-12}$ J. Thus, the total energy is: 3.309×10^{65} J, corresponding to an energy density within the R-sphere of: 3.541×10^{-14} J m^{-3}. Equalizing this with the black body energy density: $(\pi^2/15)(kT)^4/(\hbar c)^3$, we obtain: $\theta \approx 2.616$ K, which is close enough to the CMB measured temperature: 2.726 K, to confirm the above real matter density.

Now, taking $n_m = \Omega_m M/m_e$, this defines a reduced energy respective to Mc^2:

$$(n_m\hbar/R)^2/m_e = (\Omega_m/2)^2 Mc^2 = > \Omega_m' = (\Omega_m/2)^2 \approx 0.0225, \qquad (7.15)$$

which differs only by 3.7% from the above value: $\Omega_{\mathrm{H}}^{(\mathrm{r})} \approx \sqrt{(m_e/m_H)} \approx 0.0233$, for *real* matter density.

8 The Combinatorial Hierarchy

The question arises whether there is a relation between the 3 interaction constants a, a_w, and a_G. An interesting point is the remarkable (0.56% accurate) property:

$$a_G \approx 2^{127} - 1, \qquad (8.1)$$

which is a Mersenne prime number belonging to the Catalan series: indeed $127 = 2^7 - 1$, then $7 = 2^3 - 1$, and finally $3 = 2^2 - 1$, are also Mersenne prime numbers. Now their sum is $3 + 7 + 127 = 137$, which is the integer value of a, the number 137 introduced by Eddington. Note that his 'Fundamental Theory' was rejected as soon as it appeared that a is slightly distinct from 137.

The above series is known as the Combinatorial Hierarchy, which ends at the 127th power [38]. Now, 137 and a are related (within 0.12 ppm) by the formula:

$$(137^2 + \pi^2)^{1/2} \approx 137.0360157. \qquad (8.2)$$

The measured value: $a \approx 137.035999074(44)$, corresponds to a value of $\pi \approx 3.140863246$. It is to be noted that π appears in the Lenz-Wyler approximation of the proton to electron mass ratio: p (1836.153) $\approx 6\pi^5$ (1836.118). This means that the increment of a relative to the 'magic number' 137 may be related to the ratio of the masses of the two most stable particles in the Universe. This resembles the gyromagnetic ratio of the electron departing from the Dirac value 2 by an expansion in terms of the product $a\pi$ [35, 39]:

$$g_0 \approx 2 + 1\,/\,a\pi \approx 2.002322819\,(\exp 1 \approx 2.002319304). \tag{8.3}$$

Note that the Ptolemaic approximation of π: π ≈ 377/120 = 2 + 137/120 (accurate to 23 ppm) involves the 5th sum of the harmonic series:

$$\begin{array}{l} 1 \\ 1+1/2 = 3/2 \\ 1+1/2+1/3 = 11/6 \\ 1+1/2+1/3+1/4 = 5^2/12 \\ \mathbf{1+1/2+1/3+1/4+1/5 = 137/60} \\ 1+1/2+1/3+1/4+1/5+1/6 = 7^2/20 \\ 1+1/2+1/3+1/4+1/5+1/6+1/7 = 3^2 \times 11^2/420 \end{array}$$

The prime numbers in this series shows a recurrence of 11:

$$3; 11; 5^2; 137; 7^2; 11^2; \ldots. \tag{8.4}$$

which is the sum of the number 4 of ordinary space-time dimensions and the number 7 of hidden supergravity dimensions. Moreover, 4, 11, and 137, which are the maximal numbers of parts in an n-cutting process, yielding: n (n + 1)/2 + 1 (for n = 2, 4 and 16), are related by:

$$11^2 + 4^2 = 137. \tag{8.5}$$

In addition, 4 = 3 + 1 is the canonical relativistic partition of space-time while 11 = 10 + 1 relates 11, the number of supergravity dimensions, to 10, the superstring number.

As ancient Egyptians used only unitary fractions: $1/n$, they were probably aware of the special properties of 137. Indeed, the hypostyle room between the second and third pillars of the Amon temple in Karnak displays patterns characteristic of the Combinatorial Hierarchy and harmonic series. On each side of the main axis there are columns gathered in groups of 28, 21, 12, and 6. Now, 6 and 28 are 'perfect numbers' while 21 + 12 = 33, the prime number rank of 137. The total number of columns is then: 134 = 7 + 127 = 137 − 3, all these numbers appearing in the Catalan series (see above) and in the completed tetractys: 3 + 7 + 127 = 137.

The electric parameter a is related to the 'magic number' 137 not only through the above relation to π but also through the 'golden ratio' π:

$$137 \ln \pi \approx p \ln a\,/a \tag{8.6}$$

p being the proton to electron mass ratio. Equivalently, the relativistic factor in the first hydrogen orbit is (within 0.15 ppm):

$$\beta^2 = 1/(1 - 1/a^2) \approx \ln a/\ln 137. \tag{8.7}$$

Now, a direct relation is found involving the three numbers implying the electron: a, a , and $P = m_P/m$:

$$P^{10} \approx a_w^7 (\sqrt{a})^{134}, \tag{8.8}$$

which is accurate within 50 ppm. Splitting 10 as 3 + 7 and 134 as 7 + 127, one gets:

$$P^3 (P/a_w \sqrt{a})^7 \approx (\sqrt{a})^{134}, \tag{8.9}$$

where the neutron to electron mass ratio n appears:

$$P/a_w \sqrt{a} \approx n^3. \tag{8.10}$$

This relation, accurate within 90 ppm, is encountered in the systematic elimination of c in the cosmic oscillation period [16].

9 Special Holographic Conservation and Topological Axis

The following holographic expression, of type of area of a 4D-sphere: $2\pi^2 r^3$, involves very precisely the CMB wavelength: $\lambda_{CMB} = hc/k\theta_{CMB}$, yielding a temperature compatible with the measured one, $\theta_{CMB} \approx 2.7255(6)$ K:

$$2^{127} \approx 2\pi^2(\lambda_{CMB}/ƛ_e) \times (\lambda_{CMB}/ƛ_H)^2 \;\; => \;\; \theta_{CMB} \approx 2.7258204 \text{ K}. \tag{9.1}$$

This is confirmed by the following formula involving the Fermi wavelength:

$$F^5 \equiv (ƛ_e/ƛ_F)^5 \approx 6\,(ƛ_{CMB}/ƛ_e)^3 \;\; => \;\; \theta_{CMB} \approx 2.725820(1) \text{ K}. \tag{9.2}$$

This permits to propose the more accurate Fermi constant: $G_F \approx 1.43585090 \times 10^{-62}$ J m^3, corresponding to the Fermi-electron mass ratio: $F \approx 573007.325$. This is the value we use in what follows, with the corresponding CMB wavelength:

$$ƛ_{CMB} \approx 0.84007165 \text{ mm}. \tag{9.3}$$

Now, the above formula $R = 2\hbar^2/Gm_e m_p m_H$ may be written in terms of a 1D-2D holographic conservation:

$$2\pi R/ƛ_e \equiv 4\pi ƛ_H ƛ_p/l_P^2, \tag{9.4}$$

while the connection with $l_{cc} = ct_{cc}$ permits to add a 4D term implying both the Fermi and CCO wavelengths. Moreover, another 4D term clearly involves both the

CMB and neutrino (CNB) wavelengths through the characteristic ratio: $11/4 \equiv (T_{CMB}/T_{CNB})^3$, the cube of their temperature ratio:

$$2\pi R/\lambda\!\!\!^{-}_e \equiv 4\pi\lambda\!\!\!^{-}_H\lambda\!\!\!^{-}_p/l_P^2 \equiv 4\pi((\lambda\!\!\!^{-}_F l_{cc})^{1/2}/\lambda\!\!\!^{-}_e)^4 \approx 4\pi(\lambda\!\!\!^{-}_{CMB}/\lambda\!\!\!^{-}_e)^4 \times (11/4)^2\, p6\pi^5/H^2, \tag{9.5}$$

accurate within 0.1 ppm. This calls for a 3D holographic term, which gives the CMB nominal wavelength as a function of the hydrogen molecule:

$$2\pi R/\lambda\!\!\!^{-}_e \equiv 4\pi\lambda\!\!\!^{-}_H\lambda\!\!\!^{-}_p/l_P^2 \approx (4\pi/3)(\lambda\!\!\!^{-}_{CMB}/\lambda\!\!\!^{-}_{H2})^3. \tag{9.6}$$

Once more, this corresponds to a c-free calculation: starting from the constants G, $\hbar$, and the characteristic energy $k\theta_{CMB}$, one obtains a length close to the hydrogen wavelength with a geometric factor 8/3, inducing directly the above holographic relation.

Looking for a 5D term leads to the relation:

$$R/\lambda\!\!\!^{-}_e \approx (2\pi^2 a^3)^5 (H/6\pi^5), \tag{9.7}$$

where $2\pi^2 a^3$ is the area of a 4-sphere of radius a, and also the product of the perimeter by the area of a disk of radius a, a characteristic of 4D space. The correcting factor, involving the hydrogen to electron mass ratio H and the Lenz-Wyler approximation $6\pi^5$ for the proton-electron mass ratio, confirms the above proposed value G', a factor π being eliminated:

$$6R/\lambda\!\!\!^{-}_e \approx (2\pi a^3)^5 H \approx \exp(2^{26/4}). \tag{9.8}$$

This displays the bosonic dimension 26 with 1.6 ppm accuracy (see below).

According to the Holic Principle [19], the 210-D term ($2 \times 3 \times 5 \times 7 = 210$) could be relevant. Indeed one has the following relation involving the constant $k = 2R/R' = 2a^3/pH$ (with an accuracy of 15 ppm on k):

$$R/\lambda\!\!\!^{-}_e \approx (k)^{2\times3\times5\times7}. \tag{9.9}$$

Another geometric property is:

$$\pi(R/\lambda\!\!\!^{-}_e)^2 \approx \pi^{12\times13}, \tag{9.10}$$

accurate within 4.5 ppm. As $(R/\lambda\!\!\!^{-})^2 \approx 2^{256}$, this implies a relation between powers of 2 and π. The number 137 also appears as relating π and p:

$$2^{1/155} \approx \pi^{1/256} \approx (2\pi)^{1/3\times137} \approx (2p)^{1/p} \tag{9.11}$$

This example shows how the consideration of cosmic properties helps to connect physical parameters.

Moreover, the c-free length defined from $\hbar$, G and the Universe mass density is, within a geometrical factor $(8\pi/3)$, very close to $\bar{\lambda}^2/l_p$, suggesting a correspondence between G and G_F:

$$\bar{\lambda}_F\, a_G\{m_e\} \equiv \bar{\lambda}_F \hbar c/G m_e{}^2 \approx \sqrt{(8\pi/3)}R \approx 9R'/4. \tag{9.12}$$

So, the simple technique of dimensional analysis yields the temporal invariance of the horizon radius, the background temperature and the matter mean density, leading to a justification of the Perfect Cosmological Principle.

The easiest way to display large numbers from both macro- and micro-physics on a single graph is to use a double logarithmic representation. There appears a regularity that summarizes the holographic conservation laws. By alternating micro- and macro-physical numbers, the holographic relations show the series displayed in Fig. 1. A surprise is that the numeration of the large numbers appears to be the special dimension series of string theory. One can write:

$$\bar{\lambda}_e/d \sim (R/\bar{\lambda}_e)^2 \sim (\bar{\lambda}_e/l_X)^4 \sim (\lambda_{CMB}/\bar{\lambda}_e)^8 \sim (\bar{\lambda}_e/l_W)^{16} \sim (l_{at}/\bar{\lambda}_e)^{32} \sim (\bar{\lambda}_e/l_{Gl})^{64} \sim (\bar{l}_{string}/\bar{\lambda}_e)^{128} \sim 2^{256}.$$

The first two relations are well known (Weyl, Eddington, Dirac). The third one, which implies CMB, was mentioned by Davies [25]. The fourth one, that implies the intermediary boson, was noticed by Carr and Rees [11]. According to Green et al [40]:

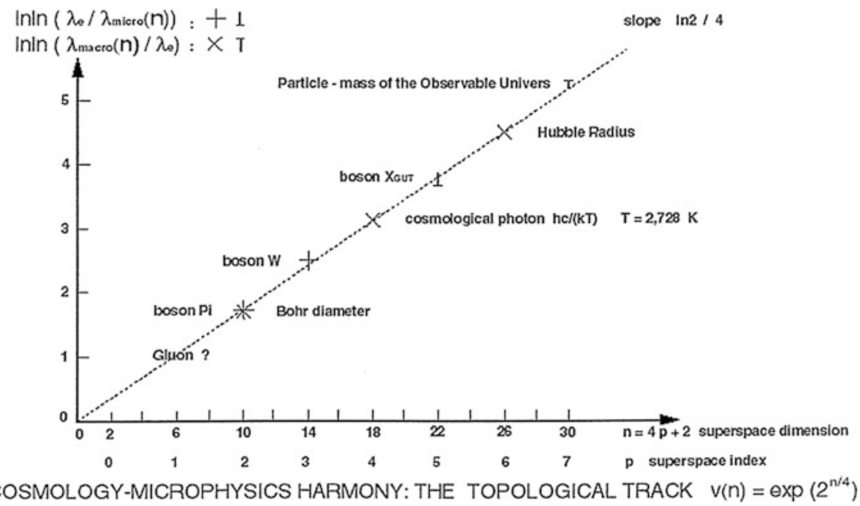

Fig. 1 Topological axis: double logarithm display of large numbers appearing in micro- and macro-physics. The x-axis numeration shows the string theory special series [40]

"In string theory, diffeomorphism anomalies arise from chiral fermions and exist only if space-time has $4p + 2$ *dimensions*". It is precisely this series that appears on the horizontal axis. Note that the gauge bosons W and X have odd p-numbers. Extrapolating to $p = 1$, this predicts a gluon mass of about 10 m_e. For $p = 7$, we get the 'holon', a new gauge boson whose mass would be that of the Universe, maybe linked to the force that repel galaxies. Note that these gauge bosons show a periodicity $\Delta n = 8$, recalling the famous Bott modulo-8 periodicity of the orthogonal group topology [41].

Note the central place of CMB on the Topological Axis. This confirms that CMB defines a special Galilean frame: its slight Doppler dissymmetry reveals an absolute speed with respect to a Grandcosmos, which can be seen as the mereging of R-radius spheres of all possible observers.

According to Polchinski [42]: *A key feature of string theory is that it is not consistent in all space-time backgrounds, but only in those satisfying certain conditions. For bosonic string theory in flat space-time, the spectrum is Lorentz-invariant only if the number of space-time dimensions D = 26. But for D > 2 the state is a tachyon*. The point $n = 26$, characteristic of bosonic string theory, relates to Hubble's radius through: $exp\ (2^{26/4}) \approx 6R/\lambda\!\!\!^{-}$ (to <0.7 ppt). The point $n = 10$, characteristic of superstring theory [40], which has been preferred to bosonic string theory for its suppression of tachyons, shows a remarkable micro-/macro-physical symmetry. Extending this to $n = 30$ (the 26 bosonic + 4 space-time dimensions) points to a *Grandcosmos*, correcting the general asymmetry of the scheme.

10 Cosmo-Biological Relations

In order to explain a number of striking correlations between various physical parameters, many people have invoked an *Anthropic Principle*, opening the way to the *Multiverse* conundrum. Strangely enough, tenants of the Anthropic Principle did not notice that some biological constants are related to physical ones. For instance, consider the DNA anhydrous nucleotide masses given in m_{H} units (Table 2). It can be seen that they follow the (0.3-ppt accurate) relation:

$$\mathrm{A} + \mathrm{T} \approx \mathrm{G} + \mathrm{C} - 1. \tag{10.1}$$

As each *bicodon* of the DNA chain is composed of 3 couples from the dual choice AT or GC, this means that bicodon masses are nearly invariant, differing by ±1H, 2H, 3H. This striking fact has apparently remained unnoticed by molecular biologists.

Now it can be seen that the 'bicodon' (6 nucleotides) mean mass m_{bc} is:

Table 2 The 4 DNA nucleotides by order of increasing mass (Uracil, which replaces Thymine for binding to Adenine in RNA, is not represented)

Name	Formula	Symbol	Mass/m_H
anhydrid desoxy-cytidine monophosphate (dCMP)	$C_9H_{12}N_3O_6P$	C	286.935
anhydrid desoxy-thymidine monophosphate (dTMP)	$C_{10}H_{13}N_2O_7P$	T	301.829
anhydrid desoxy-adenosine monophosphate (dAMP)	$C_{10}H_{12}N_5O_5P$	A	310.772
anhydrid desoxy-guanosine monophosphate (dGMP)	$C_{10}H_{12}N_5O_6P$	G	326.647

$$6(\mathrm{A}+\mathrm{T}+\mathrm{G}+\mathrm{C})/4 \approx 1839.27 \approx m_H/m_e(1837.15) \tag{10.2}$$

Note that the Fermi mass is 311.90 m_H, equal (within < 2%) to the mean nucleotide mass, 306.55 m_H. This points to a connexion between Molecular Biology and Particle Physics, which share another common point: the distinction between right and left, referred to as optical ‘chirality’ or ‘parity violation’.

We also found the quasi-symmetric relations (accurate within ~ 0.06 ppt):

$$\mathrm{A}/\mathrm{G} \approx a/6\ surd137 - 1; \quad \mathrm{C}/\mathrm{T} \approx 137/6\sqrt{a} - 1, \tag{10.3}$$

and also (within ~8 ppm and ~20 ppm respectively):

$$\mathrm{C} \approx 137(2\pi/3),] > \tag{10.4}$$

$$\mathrm{AT}/\mathrm{GC} \approx (a/137)^{3/2}. \tag{10.5}$$

This suggests that these mass ratios have the status of mathematical constants, opening the way to further study.

On the other hand, c-free dimensional analysis based on $\hbar$, G, and t_{cc} leads to the Balmer wavelength, and based on $\hbar$, G, and $2l_{cc}$ it leads (within 0.7%) to the above quasi-invariant DNA bicodon mass:

$$\hbar^2/Gm_{bc}^3 \approx 2l_{cc}. \tag{10.6}$$

So, DNA is directly connected to the absolute cosmic clock period t_{cc}. This suggests that DNA might be a cosmic linear hologram.

Consider now the common mammal temperature: $\theta_{\mathrm{mam}} \approx 310$ K, and the triple-point temperatures of Hydrogen: $\theta_{\mathrm{H2}} \approx 13.83$ K, Oxygen: $\theta_{\mathrm{O2}} \approx 54.33$ K, and water: $\theta_{\mathrm{H2O}} \approx 273.15$ K. It can be seen they are connected to the CMB temperature by the (1%-accurate) relation:

$$\theta_{H2} \times \theta_{O2} \approx \theta_{H2O} \times \theta_{CMB}. \quad (10.7)$$

On the other hand, in the relation:

$$a/(1 + \ln a) \approx e^{\pi}, \quad (10.8)$$

there appears the Sternheimer scaling factor [43]: $j \equiv 8\pi^2/\ln 2 \approx a - e^{\pi} \approx e^{\pi} \ln a$, which enters the canonical form: $(R/r_H)^{1/2} \approx e^{j/e}$. Then one has:

$$\theta_{mam}/\theta_{CMB} \approx j. \quad (10.9)$$

The symmetry between the Universe and Nambu radii is reinforced by considering the wavelengths associated with the mammal and triple-point water temperatures: $\lambda_{mam} \equiv hc/k\theta_{mam}, \lambda_{H2O} \equiv hc/k\theta_{H2O}$. It can be seen that the following relations hold, within 1% and 0.1% respectively:

$$(Rl_P)^{1/2} \approx \lambda_{mam}, (R' l_P)^{1/2} \approx \lambda_{H2O}. \quad (10.10)$$

Here it should be recalled that, according to Schrödinger [44], temperature plays an essential role in Life. Indeed, mammal temperature is the same for the polar bear as for the african antelope, which may appear as a waste of energy [45]. It is as if the water molecule and mammal organisms were far more important, from the conjectured 'cosmic computer viewpoint', than that of CMB. This may be seen as reverse of the 'Anthropic Principle': the Cosmos would use 'human terminals' in its computing research. This may suggest an answer to the question: '*why do we ask questions*'?

We now proceed to relations involving the amino-acids making up proteins.

Table 3 displays the masses of these amino-acids in m_H units. The mean arithmetic and geometric values of the 20 normal amino-acids are, respectively:

$$\langle 20\,AA \rangle_{arith} \approx 135.75, \quad \langle 20\,AA \rangle_{geom} \approx 132.40. \quad (10.11)$$

Adding the two abnormal amino-acids, the mean values become:

$$\langle 22\,AA \rangle_{arith} \approx 142.50, \quad \langle 22\,AA \rangle_{geom} \approx 137.71. \quad (10.12)$$

One observes that:

$$\langle 20\,AA \rangle_{arith} + 1 \approx \langle 22\,AA \rangle_{geom} - 1 \approx 136.7. \quad (10.13)$$

Now the product of the 22 AA masses is, with $P = m_P/m_e$ and $(a_w)^{1/2} = F = m_F/m_e$:

Table 3 The 20 regular amino-acids by order of increasing mass, followed by the 2 *irregulars ones*

Name	Formula	Symbol	Mass/m_H
Glycine	$C_2H_5NO_2$	Gly/G	074.48
Alanine	$C_3H_7NO_2$	Ala/A	088.40
Serine	$C_3H_7NO_3$	Ser/S	104.27
Proline	$C_5H_9NO_2$	Pro/P	114.23
Valine	$C_5H_{11}NO_2$	Val/V	116.24
Threonine	$C_4H_9NO_3$	Thr/T	118.19
Cysteine	$C_3H_7NO_2S$	Cys/C	120.22
Leucine	$C_6H_{13}NO_2$	Leu/L	130.15
Isoleucine	$C_6H_{13}NO_2$	Ile/I	130.15
Asparagine	$C_4H_8N_2O_3$	Asn/N	131.09
Aspartic acid	$C_4H_7NO_4$	Asp/D	132.08
Glutamine	$C_5H_{10}N_2O_3$	Gln/Q	145.01
Lysine	$C_6H_{14}N_2O_2$	Lys/K	145.05
Glutamic acid	$C_5H_9NO_4$	Glu/E	145.99
Methionine	$C_5H_{11}NO_2S$	Met/M	148.05
Histidine	$C_6H_9N_3O_2$	His/H	153.95
Phenylalanine	$C_9H_{11}NO_2$	Phe/F	163.91
Arginine	$C_6H_{14}N_4O_2$	Arg/R	172.85
Tyrosine	$C_9H_{11}NO_3$	Tyr/Y	179.78
Tryptophan	$C_{11}H_{12}N_2O_2$	Trp/W	202.64
Selenocysteine	$C_3H_7NO_2Se$	*Se-Cys*	*166.74*
Pyrrolysine	$C_{12}H_{21}N_3O_3$	*Py-Lys*	*253.33*

$$(137.71)^{22} \approx 3aP^2/2 \approx (aF)^6/2. \qquad (10.14)$$

Coming back to the *central holographic relation* implying the absolute Kotov clock:

$$3(P/a)^2 \approx (aa_w)^3 \approx (T/t_{cc})^3. \qquad (10.15)$$

In addition, one can see that:

$$(3P^2)^{1/22} \approx 113.78 \approx j, \qquad (10.16)$$

showing another connection between the electric constant a and the Sternheimer scale factor j through the ratio P between the Planck and electron masses. These remarks confirm that elementary masses play an unsuspected but important role in Biology.

It may be interesting to investigate whether larger biological properties are related to elementary constants occurring in micro- or macro-physics. Actually, it is found that the mass m_{00} of the largest human cell (ovocyte), with a diameter of ~120 μm [46], is about $m_P/3$ (pig ~ $m_P/4.5$, hamster ~ $m_P/10$, mouse ~ $m_P/14$), m_P

denoting the Planck mass (~ 22 μg). We found a further correlation between the number of actual protein-coding genes making up the human genome, estimated to about 20,500 from evolutionary comparisons [47], and universal constants:

$$m_{00}/2m_e \approx P/6 \approx (20890)^5 \approx (r_H/\lambda_H)^4 \approx (\lambda_{CMB}/r_H)^3 \approx [2\sqrt{(R'/R)}]^{60}, \quad (10.17)$$

where 20,890 is close (within < 2%) to the above gene number.

11 The Harmonic Principle

In a masterly review paper, Maruani et al. [48] have shown that musical patterns occur at various levels of complexity. If macrophysics constants are related to microphysics ones and affect atoms and molecules up to biosystems, then one may expect these constants to occur also in musical patterns. Indeed, following a tradition going back to Pythagoras, we propose a *Harmonic Principle* stating that there is a connection between the canonical numbers appearing in music and physical parameters. In the Jeans classification of the 'best' musical scales [49], obtained by the so-called 'continuous fraction' analysis, there are, following the 12 degrees of the western even-tempered scale, numbers of notes of 41; 53; 306; ….

First notice that Western music involves a large number correlation: $2^{19} \approx 3^{12}$, showing a connection with the 'golden section' $\phi = (1 + \sqrt{5})/2$. One can see that, within ~ 1.5%:

$$2^{19} \approx 3^{12} \approx \phi^{137/5}. \quad (12.1)$$

Thus, the ancestral problem of connecting the golden section with music is solved by introducing the 'magic number' 137. This is not a property of the sole Western scale, for in the ancient Han Chinese 60-interval scale one has, within ~ 0.9%: $3^{60} \approx \phi^{137} \sim 4.3 \times 10^{28}$, a large integer already quoted [19] for its special properties. Equation (12.1) also shows that the 5th harmonic sum 137/60 appears as the exponent of ϕ τo yield 3, the optimal integer basis (between e and π).

Note that the optimal integer basis 3 correlates (within 12 ppm) the ratios F/a and $a/137$, where F is the Fermi to electron mass ratio (Table 1):

$$3 \approx (a/137)^{F/a}. \quad (12.2)$$

Music experts divide the tone (about a sixth of the octave) into 9 commas, 4 forming a minor semi-tone and 5 forming a major semi-tone, yielding 9 × 6 = 54 commas in the octave. Indeed the Hindustan scale uses 53 intervals, and the perfect number 6 appears as the 137th one:

$$2^{1/53} \approx 3^{1/84} \approx 6^{1/137}. \quad (12.3)$$

It should be noted that the comma is distinguished by violinists, if not by pianists. But the presence, in the following scale, of the number $306 \approx p/6 \approx \pi^5$ (accurate within 20 ppm) is even more dramatic. One has,

$$3^{1836/3}(p/2a) \approx a^a \approx \exp\left[(2\pi)^3 e\right]. \quad (12.4)$$

The operational definition of the optimal basis e is that $e^{1/e}$ is maximal, and 3 is the integer closest to e. Indeed, in computer theory, it is known that using a computing basis 3 would be far more efficient than the commonly used digital basis 2, notwithstanding technical problems. In 1712, Leibnitz wrote to Christian Goldbach: '*Music is a secret exercise on numbers*'. We elaborate on this by conjecturing that the brain is a multi-basis computer using mainly the bases 2, 3, 5, and 137, which appear in the harmonic series discussed above.

Note that physical properties may also show arithmetic properties obeying an 'economy principle', i.e. they can be expressed as large numbers involving only one or two small numbers. For instance, one has (within 0.6 and 0.03%, respectively):

$$R/\lambda_e \approx 2\hat{}(2\hat{}7), \; R'/\lambda_e \approx (3\hat{}3)\hat{}(3\hat{}3). \quad (12.5)$$

Both the Cosmos R and 'Grandcosmos' R' radii exhibit 'economic numbers', expressed using the two simple integer bases 2 and 3. All this cannot be due to chance, and calls for a *Diophantine Grand Theory*.

12 Conclusions

The reductionist point of view is to consider the Universe as a mere ensemble of particles in c-limited probabilistic interaction, this resulting in a separation between scientific domains such as Cosmology and Biology. The opposite, holistic approach leads, on the contrary, to the unification of the scientific domains. Even microphysics cannot really be understood without involving Cosmology, which sheds light onto the famous problem of hidden 'local' variables. The strong arguments in favor of a 'computing Cosmos' make intelligent life likely in the whole Universe.

The misleading formalism was to choose a system of units with $c = 1$ in relativistic quantum mechanics, leading to confusion between space and time coordinates while they transform differently in the relativistic formulas. This prevented recognition of the essential role of dimensional analysis, which we related to extended holographic principles and lead us to the temporal invariance of the Universe horizon, mean density, and microwave background temperature.

While the common interpretation of quantum mechanics is of a statistical nature, our deterministic point of view is that the Cosmos 'has no choice': *the origin of the* *physical laws is in pure numbers*. As a result, one may discard the theory of biological evolution through natural and sexual selection of randomly occurring micromutations, for an organism is a whole entity and there is an overwhelming lack of intermediate fossils. Our conjecture is that macromutations would be monitored by a 'computing Universe' which uses $a \approx 137$ as an optimal basis. Indeed, our 'Grandcosmos' volume (in units of the Bohr radius) is precisely: $V' = a^a/\pi$.

The physical interactions have been replaced in a cosmic context, which led us to a proposal for the graviton and photon masses. Experimental refutations of de Broglie's search for a 'double solution' and of Einstein's conjecture of 'hidden *local* variables' cannot be seen as a triumph of Bohr's 'completeness' idea, which has a reductionist flavor, because these views do not include *the cosmos as the source of hidden variables* in a holistic approach.

This study was initiated by a simple idea: the conservation of geometric forms of different dimensions, in analogy with the holographic technique. This led us to very accurate relations between canonical physical ratios. The standard view is to attribute them to chance, which leads to the Multiverse conjecture and Anthropic principle. But we showed that these relations involve such special numbers as π, e, ϕ and a, as well as whole numbers occurring in string theory. This means that the traditional idea of a unique Universe should be restored, and Eddington's Fundamental Theory reassessed.

From our holographic conservation rules we have derived a 'flickering Universe' model, involving a high-frequency matter-antimatter oscillation. In fact, holographic relations reveal more than a simple geometric analogy. The related 'Coherence Principle' can be linked to the fact that holographic techniques use a coherent, monofrequency radiation. It may be inferred that waves associated with particles have some mutual coherence. In 'Coherent Cosmology' a single frequency is at work: $f = h/E \approx 10^{104}$ Hz, which can be interpreted as a matter-antimatter oscillation. 'Dark matter' could then be seen as having an oscillation in 'phase quadrature'. This can be related to de Broglie's remark on *Zitterbewegung* being a 'beat' between the electron and positron waves [50], as noted by Maruani [35]. Within this model, we have found striking relations between Newton's and Fermi's constants, and used the 10^{-6}-accurate value of the latter to propose a more accurate estimate of the former.

This leads to the idea of a 'Computing Universe' using the fundamental physical constants as optimal calculation bases. Living beings would be peripherals designed and used by this overseeing 'natural intelligence'. The non-deterministic interpretation of quantum mechanics would be replaced by hidden determinism. 'Hidden variables' would simply be, in line with Mach's intuition, the rest of the Cosmos and, of course, subject to non-locality. But strict non-locality would also be excluded, for it would involve infinite velocity. We have proposed that superspeeds are at work, such as that ($C_g > 10^{36}c$) recently proposed by Maruani [51].

Other conclusions of the present work and conjectures for future work are listed in the following. **1**. *Quantification Principle*: at the end, physical laws are arithmetical, excluding infinity and continuum. **2**. *Coherence Principle*: a unique frequency governs all phenomena in the Universe, particles and molecules, DNA chains, living cells, and whole organisms. **3**. *Vibrating Principle*: the Universe is vibrating with a periodicity $t = h/E = 2t_P^2/T$, where $E = Mc^2$ with $M = Rc^2/2G$. The period of the matter-antimatter vibration of each particle is a whole multiple of t or, equivalently, its mass is a whole sub-multiple of M. **4**. *Holographic Principle*: fundamental physical laws result from holographic conservations—in fact dimensional transfers. **5**. *Grandcosmos Principle*: an external thermostat, with radius $R_{GC}= R'^2/2l_P$, is the source of both CMB and CNB. **6**. *Computing Principle*: universal numerical constants act as computational bases for a Computing Universe. **7**. *Immergence Principle*—Inverted Anthropic Principle: Life helps in cosmic computations; biological parameters are tied to cosmic constants.

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