SPACE-TIME QUANTIFICATION

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May 22, 2022

Abstract

The quantification of Length and Time in Kepler's laws implies an angular momentum quantum, identified with the reduced Planck's constant, showing a mass-symmetry with the Newtonian constant G. This leads to the Diophantine Coherence Theorem which generalizes the synthetic resolution of the Hydrogen spectrum by Arthur Haas, three years before Bohr. The Length quantum breaks the Planck wall by a factor 10^{61}, and the associated Holographic Cosmos is identified as the source of the Background Radiation in the Steady-State Cosmology. An Electricity-Gravitation symmetry, connected with the Combinatorial Hierarchy, defines the steady-state Universe with an invariant Hubble radius 13.812 milliard light-year, corresponding to 70.793 (km/s)/Mpc, a value deposed (1998) in a Closed Draft at the Paris Academy, confirmed by the WMAP value and the recent Carnegie-Chicago Hubble Program, and associated with the Eddington number and the Kotov-Lyuty non-local oscillation. This confirms definitely the Anthropic Principle and the Diophantine Holographic Topological Axis rehabilitating the tachyonic bosonic string theory. This specifies G, compatible with the BIPM measurements, but at 6 σ from the official value, defined by merging discordant measurements.

Mai 2022

1 The Diophantine Coherence Theorem (DCT)

For connecting different physical measurements, Physics uses multiplication while addition is forbidden. But multiplication is a generalization of addition [26]. This paradox may be suppressed by considering only numerical ratios of the same physical quantity, as in the third Kepler law, *introducing Space and Time quanta* L_1 and T_1 [37]. Considered as a Diophantine Equation, which uses only natural numbers n, it resolves directly :

$$(T_n/T_1)^2 = (L_n/L_1)^3 \equiv n^6 \quad \Rightarrow \quad T_n = n^3 T_1 \;\; ; \;\; L_n = n^2 L_1 \quad . \qquad (1)$$

This proceeds from the Holic Principle [32], a Diophantine form of the Holographic Principle, which states that the nature of a physical ratio is related to its exponent identified with its topological dimensions : 3 for Space, 2 for a 2D Time [3], 5 for Mass, and 7 for Field. The Simplest Diophantine Equation

$Y = X^2$ is the basis of the Topological Axis, the skeleton of the cosmic mass spectrum [36].

The n-invariant L_n^3/T_n^2 is homogeneous to Gm_G, where G is Newton's gravitational constant, and m_G is a mass (here the usual central mass is divided by the factor $4\pi^2$). The other Kepler's law states that the orbital angular momentum per unit mass is an orbital invariant. Since the corresponding term L_n^2/T_n is proportional to n, this implies an orbital momentum quantum, identified to the reduced Planck constant, or *action quantum* $\hbar$, privileged by the the spin concept in particle physics. While the ratio of the kinematic parts of G and $\hbar$ are homogeneous to a speed, these two universal constants presents a symmetry by respect to the mass concept, implying the association of $\hbar$ with a mass $m_\hbar$:

$$L_n^3/T_n^2 = Gm_G \quad ; \quad L_n^2/T_n = n\ \hbar/m_\hbar\ . \tag{2}$$

Any mass pair $(m_G, m_\hbar)$ is associated to a series of Keplerian orbits (L_n, T_n) :

$$L_n = \frac{(n\ \hbar)^2}{Gm_G m_\hbar^2} \quad ; \quad T_n = \frac{(n\ \hbar)^3}{G^2 m_G^2 m_\hbar^3} \quad . \tag{3}$$

For n = 1 and $m_G = m_\hbar = m$, the Special Non-Local Length and Time are:

$$L_{SNL}(m) = \frac{\hbar^2}{Gm^3} \quad ; \quad T_{SNL}(m) = \frac{\hbar^3}{G^2 m^5} \quad . \tag{4}$$

Introducing the *formal* velocity $V_n = L_n/T_n$, this connects the reduced Planck energy $n\ \hbar/T_n$ with the gravitational potential energy between the to couple (m_G, $m_\hbar$) and with the energy $m_\hbar V_n^2$:

$$V_n = L_n/T_n = Gm_G m_\hbar/n\ \hbar \quad \Rightarrow \quad n\ \hbar/T_n = Gm_G m_\hbar/L_n = m_\hbar V_n^2\ . \tag{5}$$

With the Planck mass $m_P = \sqrt{\hbar c/G}$, where the light speed c is the third universal constant, this reads

$$\frac{n\ \hbar}{T_n} = \frac{Gm_G m_\hbar}{L_n} = m_\hbar V_n^2 \equiv m_\hbar \left(\frac{c}{nA}\right)^2 \quad ; \quad A = \frac{m_P^2}{m_G m_\hbar} \quad . \tag{6}$$

This is called the *Diophantine Coherence Theorem* (DCT).

2 The Atom H and the Holographic Cosmos

Three years before Bohr, Arthur Haas [15] considered *the electron orbital period* in the Rutherford model, and the corresponding Planck energy $nh\nu = nh/T_n = n\ \hbar v_n/L_n$ where $v_n = 2\pi V_n$ is the orbital velocity. The correct Hydrogen spectrum is obtained by equalizing it with the electric potential energy $\hbar c/aL_n$, where $a \approx 137.0359991$ is the electric constant, and the double (virial) kinetic electron energy $m_e v_n^2$ (the useful physical constants are listed in Table 1):

$$n\ \hbar\frac{v_n}{L_n} = \frac{\hbar c}{aL_n} = m_e v_n^2 \equiv m_e \left(\frac{c}{na}\right)^2 \ . \tag{7}$$

Note that the so-called "properties of vacuum" ϵ_0 and μ_0 are unnecessary : they are only introduced for historical reasons, leading to the cumbersome, but official, choice of electrical units, hiding the true "electrical constant" a, whose inverse α, called "the fine structure constant" is of minor importance. For $n = 1$, this gives the bare Hass-Bohr radius: $r_{HB} = a\lambda\!\!\!^{-}_e$, where $\lambda\!\!\!^{-}_e \equiv \hbar/(m_e c)$ is the Reduced Electron wavelength (the effective electron mass effect defines the Bohr radius $r_B = r_{HB} \times (1 + 1/p)$). This double equation shows up the same form that the above DCT (6), where additional 2π factors are integrated in the definitions of m_G and $m_\hbar$. The identification of potential energy terms implies $m_G m_\hbar = m_P^2/a$, thus in this case $A = a$. The simplest choice $m_\hbar = m_e$ implies the following m_G, where $m_N = a m_e$ is *the Nambu mass, a quasi-quantum in Particle Physics* [23]:

$$m_\hbar = m_e \quad ; \quad m_G = \frac{m_P^2}{m_N} \; ; \qquad A = a \; . \tag{8}$$

This last mass is $m_G \approx 3.7939 \times 10^{12}$ kg, whose corresponding Special Non Local Length (4) is :

$$d_0 = L_{SNL}(m_P^2/m_N) \approx 3.051 \times 10^{-96} \text{ meter.} \tag{9}$$

This is the Cosmic Space Quantum breaking the "Planck Wall" by a factor 10^{61} which has been associated to the Cosmos holographic radius R_{hol}, defined by the Bekenstein-Hawking Entropy formula [7], where the *Planck Length* $l_P \equiv (G\hbar/c^3)^{1/2} \equiv L_{SNL}(m_P)$ is a basic holographic length [36]:

$$\pi \left(\frac{R_{hol}}{l_P} \right)^2 = 2\pi \frac{R_{hol}}{d_0} \;\; \Rightarrow \; R_{hol} = 2L_{SNL}(m_N) \approx 18.105 \text{ Giga light-year (Glyr)}, \tag{10}$$

which is a typical cosmic length. The Cosmos radius R_C has been defined by the natural *mono-chromatic* holographic extension :

$$\pi \left(\frac{R_{hol}}{l_P} \right)^2 = 2\pi \frac{R_{hol}}{d_0} \; = 2\pi \frac{R_C}{l_P} \;\; \Rightarrow \; R_C = 2L_{SNL}(m_N^2/m_P) \approx 9.075 \times 10^{86} \text{ m}, \tag{11}$$

which is related to the above Haas-Bohr radius r_{HB} by the 10 ppm quasi holographic formula :

$$\frac{4\pi^2}{3} \left(\frac{p}{n_t} \right)^2 \left(\frac{R_C}{r_{HB}} \right)^3 = a^a \; , \tag{12}$$

showing a significative role of the Electric constant a, implying it is a *calculation basis [39], in concordance with the quantification of Space-Time* [13].

Introducing $\lambda_{hol} = \sqrt{l_P \, L_{SNL}(m_N)} \equiv L_{SNL}(\sqrt{m_N m_P})$, it enters an extension of the Holographic Principle:

$$\left(\frac{\lambda_{hol}}{l_P} \right)^2 = \frac{l_P}{d_0} \quad , \tag{13}$$

which is the above basic holic form at the basis of the Topological Axis [34]. This wavelength λ_{hol} enters also the following dramatic holographic relations involving the wavelengths of the Electron, the Hydrogen, and the Weak Bosons W (0.3 ppm):

$$4\pi\sqrt{\beta} \frac{\lambda_{hol} \lambda\!\!\!^{-}_W}{\lambda\!\!\!^{-}_H{}^2} \; = \frac{4\pi}{3} \; (\frac{\lambda\!\!\!^{-}_e}{\lambda\!\!\!^{-}_H} \;)^3 \tag{14}$$

where $\pi\sqrt{\beta} \approx 3+(7+1/\sqrt{2\times 137})^{-1}$. The involved term $HW \approx Ze^{e^2}(\pi_q/\pi)\sqrt{(p/p_W)}$ (30 ppb), implying the corrected π_q value defined by the adimensional electric charge $q = (4\pi_q/a)^{1/2} = W sin\theta/H^{(0)}$, with $\cos\theta = W/Z$. This means that *the heart of Physics is the following holographic relations*:

$$\frac{a+1}{a}\,4\pi\,(e^{\pi})^2 \approx \frac{4\pi}{3}\,e^{e^2} \approx \frac{4\pi}{3}\,a^{3/2}\frac{d_e(a+1)}{137} \approx \frac{1}{2}\sqrt{\frac{aa_w}{H^0}} \approx F\frac{F}{10a_s} \approx \frac{9\mu\sqrt{aa_w}}{W\sqrt{137}}\,, \tag{15}$$

where the tau mass appears in the relations $9\mu/\tau \approx g_1/g_2 \equiv \tan\theta$ and $W^2 \approx 2\tau Z\sin\theta(H^0/a)^{1/2}$.

These formula leads to the following ppb relation, showing a role of the geometrical factor 4π :

$$\left(\frac{P}{a_w}\right)^3 \approx \left(\frac{4\pi}{\sqrt{a}}\right)^8 \frac{(pH\beta^2)^5}{2} \approx \frac{aW}{137\,Z}\,(pH)^5 \qquad (16\ \text{ppm}), \tag{16}$$

The Table 2 shows the symmetry between the Nambu mass m_N and the Planck mass m_P, whose large value is the source of the "Hierarchical Problem" [31]. Now $\lambda_{hol} \approx \lambda_{CMB}/2a_s^2$, where $2a_s^2 \approx a$, tying to 0.3 % the strong coupling a_s and the nominal wavelength hc/kT_{CMB} of the Cosmic Micro-onde Background (CMB), whose source is lacking in the steady-state cosmology [6], [16]. The simplest hypothesis is that the above Cosmos is this source. Indeed, the Wien CMB wavelength λ_{Wn} enters :

$$4\pi\left(\frac{R_{hol}}{\lambda_{Wn}}\right)^2 \approx e^a \qquad (0.1\%). \tag{17}$$

This perfect holographic formula suggests that *the CMB would be coherent, meaning it brings information.* This could be the real signification of the CMB Anisotropy Statistics [1].

3 The Gravitational Dihydrogen

The Haas method was already applied to the *special three-body* gravitational dihydrogen [34, p.391]:

$$n\,\hbar\frac{v_n}{L_n} = \frac{Gm_pm_H}{L_n} = m_e v_n^2\,, \tag{18}$$

The comparison with the above Haas equation implies the substitution : $a \to a_G = m_P^2/m_pm_H$, corresponding to the following m_G value :

$$m_\hbar = m_e \quad ; \quad m_G = m_{bc}\ ; \quad A = a_G \tag{19}$$

where $m_{bc} = m_pm_H/m_e$ is close to the DNA bi-codon mass [34], (DNA = Desoxyribo Nucleic Acid), which shows a central position in the Topological Axis [34], corresponding to the dimension 16. Indeed the corresponding topological term e^{16} is close to pHR_{hol}/R_{H_2}, and, more precisely, to $2n_t^4/a^3$ (0.04 %).

For n = 1, this Haas-Sanchez radius R_{H_2} shows a direct Electricity-Gravitation symmetry, by respect to the Reduced Electron wavelength $\lambda\!\!\!^{-}_e = \hbar/m_ec$, where

$m_0 = (m_e m_p m_H)^{1/3}$:

$$
\begin{aligned}
r_{HB} &= a\lambda\!\!\!^{-}_e = a\frac{\hbar}{m_e c} \\
R_{H_2} &= a_G\lambda\!\!\!^{-}_e = \frac{\hbar^2}{G m_e m_p m_H} \equiv L_{SNL}(m_0) \approx 6.906 \text{ Glyr.}
\end{aligned}
\tag{20}
$$

Note that a and a_G are very close to the last two terms of the Combinatorial Hierarchy 137 and $N_L + 137$, with $N_L = 2^{127} - 1$, the Lucas Number [4]. It was noted that the implied Mersenne numbers 3,7,127 relates the gravitational main large number $P = m_P/m_e$ with the weak parameter $a_w = (m_F/m_e)^2$ and $\sqrt{a}$ in the following relation, and the rearranging of the exponents shows the above neutron ratio:

$$
P^{3+7} \approx a_w^7 \sqrt{a}^{\;7+127} \quad (57ppm) \qquad \Rightarrow \qquad \frac{P}{a_w}\sqrt{a} \approx (\sqrt{a}^{127}/P^3)^{1/7} \approx n_t^3 \,. \tag{21}
$$

In the gravitational dihydrogen radius formula R_{H_2}, the speed c is eliminated: for this reason, a precise approximation was immediately guessed by the c-free "dimensional analysis", the so-called *Three Minutes Formula*, from the ternary symmetry Electron-Proton-Neutron (Closed Letter to the Paris Science Academy, March 1998) [33] (Table 2). Indeed, the speed c is far too small a speed to explain the cosmic coherence manifested by the Foucault pendulum (Mach Principle).

The Special Non-Local Time $T_{SNL}(m_0)$ is very close (0.9 %) to the time given by the triplet : $(\hbar, G_F, \rho_{cr})$, with the Fermi constant G_F and the critical steady-state density $\rho_{cr} = 3c^2/8\pi G R^2$ with horizon radius $R = 2R_{H_2}$: it is $\hbar^4/G_F^{5/2}\rho_{cr}^{3/2}$, introducing the steady-state Universe of radius $R = 2R_{H_2}$ discussed now.

4 The Steady-State Universe re-established

A salient feature of the observed Universe is its critical character, relating its horizon radius R with its mass by $R = 2GM/c^2$. However, in the initial "flat universe" model [12], the total mass M is only matter, while in the present ΛCDM standard model, it is separated between a material part, with relative density Ω_m, and a so-called "dark energy" part with relative density $1 - \Omega_m$ [1]. We have noted that Ω_m is compatible with $3/10$, which is both the relative density of the classical gravitational energy of a critical homogeneous ball and the relative density of the steady-state *non-relativist* recession kinetic energy [36]. While the standard cosmology uses an ad-hoc inflation to justify this observed critical condition, we consider rather the Universe as a particle (Topon) in the above Cosmos, with the Topon wavelength $\lambda\!\!\!^{-}_M \equiv \hbar/Mc = 2\hbar\ G/Rc^3 \equiv 2l_P^2/R$. Then, the critical condition results from the Bekeinstein-Hawking entropy holographic relation, as above (Eq. 10), where the Topon appears as a Length Quantum, since the wavelength $\lambda\!\!\!^{-}_m$ associated for any particle of mass m is a whole multiple n_m of the Topon, in conformity with the Field Quantum Theory. The geometrical interpretation is clear : *it is a sphere area described by a whole* *number of sweeping circles, illustrating the fact that multiplication is a series of additions, an approximation supporting the vastness of the world* [36]:

$$4\pi\left(\frac{R_{HB}}{l_P}\right)^2=\pi\left(\frac{R}{l_P}\right)^2=2\pi\frac{R}{\lambdabar_M}\equiv 2\pi n_m\frac{R}{\lambdabar_m}\quad\Rightarrow\quad M=\frac{Rc^2}{2G}\equiv\frac{R_{H_2}c^2}{G}\ , \tag{22}$$

identifying twice the above Haas-Sanchez's gravitational radius R_{H_2} with R, the steady-state Universe horizon radius, which is also *the limit of a theoretical star radius when its number of atoms shrinks to one [10], a central length in astrophysics which induces a coefficient-free Universe Mass Relation*:

$$R=2\frac{\hbar^2}{Gm_em_pm_H}\approx 13.812\ \text{Glyr}\quad\Rightarrow\quad M=\frac{m_P^4}{m_em_pm_H}\ . \tag{23}$$

This is called the *Machian Formula*. Recall that the standard General Relativity in unable to explain the Mach Principle. With the effective electron mass $m_e'=m_em_p/(m_p+m_e)\equiv M/n_e$, this introduces n_e, the *Universe Electron Quantum Number*, canonical in Quantum Field Theory. The Eddington's Electron-Proton symmetry shows up in the following *resolution of the so-called Large Number Problem*, where $\lambdabar_{pH}$ is the geometrical mean of the reduced wavelengths of the proton and Hydrogen:

$$\frac{m_P^2}{m_pm_e}\equiv\sqrt{n_e}\equiv\frac{R}{2\lambdabar_{pH}}\ , \tag{24}$$

which is extended by very precise dramatic expressions involving the symmetry between the weak bosons of masses $m_W=Wm_e$ and $m_Z=Zm_e$, specifying the known relation $a_G\approx W^8$ [9]:

$$\sqrt{n_e}\approx\frac{(WZ)^4}{2}\approx\left(\frac{m_F^2}{m_pm_H}\right)^7\left(\frac{aZ}{W}\right)^3\ , \tag{25}$$

where appears as well a Planck-Fermi symmetry, enlighting the "Hierarchical problem" [31].

In the Topological Axis, the above Topon corresponds to the orbital number $k=7$, while the gauge bosons corresponds to $k=3$ (weak bosons W,Z) and $k=5$ (strong GUT boson X), letting a single place $k=1$ for a *non-standard massive* Gluon [36].

The particular values of the topological function $f(k)=e^{2^{k+1/2}}$ for k = 7 and 6 show up in (0.06%):

$$\sqrt{n_e}/153\approx\sqrt{f(7)}\equiv f(6)\approx 6R/\lambdabar_e. \tag{26}$$

implying that $m_p/m_e\approx 1836\equiv 6\times 2\times 153$, the Diophantine approximation of the Wyler formula $p_W=6\pi^5$ [43]. This is a dramatic confirmation of the Topological Axis pertinence. The spectroscopic number associated to k is $2(2k+1)$, where 2 is the spin degeneracy and $2k+1$ the number of magnetic states [37]. For $k=6$, this is 26, the canonical dimension in the bosonic string theory [31].

This *invariable* Universe radius $R\approx 13.812$ Giga light-year (Glyr) of Eq. (23) is close to c times the variable standard Universe age. So the standard theoretical approach is correct, but not its Big Bang interpretation : a confusion is made between Time and Length, which readily occurs by putting $c = 1$. Moreover, the corresponding Hubble constant c/R is 70.793 (km/s)/Mpc, which is compatible with both the WMAP and the Carnegie-Chicago Hubble Program recent direct measurements (Table 3).

The above Universe gravitational potential energy $(3/10)Mc^2$ shows a Neutron Quantum Number (the number of neutron masses) very close (0.05 %) to the large Eddington Number [36]. So it has nearly anticipated the correct Hubble Constant value (Table 3).

The theoretical prediction [9] that a is the order of lna_G was specified in the Single Electron Cosmical Radius R_1, [38], leading to the 0.4 ppm connection : $R_1 \approx (RR_{hol}\beta)^{1/2}p_G/p_W$, with $p_W = 6\pi^5$ and $p_G = m_P/\sqrt{N_L}m_e \approx$ 1831.530 547, which shows the following ppb relation, a symmetric extension of $a^2 \approx 137^2 + \pi^2$:

$$p_G^2 \approx pH - 137^2 - \pi^2 - e^2. \tag{27}$$

The cosmos radius R_C and the holographic mass $M_{hol} = R_{hol}c^2/2G$ connect with the ratio $R/\lambda\!\!\!^{-}_e \equiv T/t_e$ through the Cosmos-Universe couple MLT Formula (1%) [37]:

$$\left[\ln\left(\frac{R_C}{\lambda\!\!\!^{-}_e}\right)\right]^2 \approx \left[\ln\left(\frac{M_{hol}}{m_e}\right)\right]^2 + \left[\ln\left(\frac{R}{\lambda\!\!\!^{-}_e}\right)\right]^2 + \left[\ln\left(\frac{T}{t_e}\right)\right]^2 . \tag{28}$$

Moreover, the Cosmos radius connects with the above radius R_{hol} and R by (-0.7 ppm and 0.6 ppm), with the deviant forms (Archimède) $\pi_{Arc} = 22/7$ and Ptolémée, wher 17 is replaced by τ/μ : $\pi_{\tau/\mu} = 3 + (7 + \mu/\tau)^{-1}$:

$$\beta R_C \left(\frac{m_e}{m_P}\right)^2 \approx R_{hol}\left(W\frac{H}{3}\right)^2 \approx R(2F\,Z^2/3)\frac{(4\pi_{Arc}/3)}{\pi_{\tau/\mu}} . \tag{29}$$

implying the following confirmation of the Holographic Principle, syronger than the analytic π, where $4\pi_{Arc}/3 \approx \sqrt{a}n_t/4\pi p_W(\sin\theta)^2$ (0.15 ppm) :

$$u = \frac{R_{hol}}{R} = \frac{pK}{a^3} \approx \frac{(4\pi_{Arc}/3)\lambda\!\!\!^{-}_e{}^3/\lambda\!\!\!^{-}_F\lambda\!\!\!^{-}_Z{}^2}{2\pi_{\tau/\mu}(\lambda\!\!\!^{-}_{hol}/\lambda\!\!\!^{-}_e)^2} \tag{30}$$

With Eq (13), the elimination of Z/W implies a new 0.3 ppm formula for R (Table 3). Taking accpunt of the above relation $WH \approx Ze^{e^2}$, this leads to the 0.6 ppm relation :

$$\frac{6F}{(e^2)^{e^2}} \approx \frac{(H+1)^2}{a^3} \tag{31}$$

The ratio $u = R_{hol}/R \equiv pH/a^3 \approx 1.310\,841\,007$ shows high correlation with Particle Physics:

$$u \approx \frac{\pi Z}{eW} \approx (\frac{F\sin\theta}{W})^{1/2} \approx \frac{a_s Z}{2F} \approx \frac{qd_e^4\sqrt{a}}{e} \approx \frac{3 \times 137 \times H^{(0)}}{\pi a Z} \approx \frac{4\pi g_3}{\sqrt{a}} . \tag{32}$$

where $g_3 = g_1 g_2/g_0$, with $g_0 = pp_G/2a^3$, confirming the holistic character of Quantum Cosmology.

5 The Cosmic Microwave Background (CMB)

This Universe radius $R = 2R_{H_2}$ enters a 1D-2D holographic relation: $2\pi R/\lambdabar_e = 4\pi\lambdabar_p\lambdabar_H/l_P^2$. The extension to the 3D holographic relation using $\lambdabar_{H_2}$, the reduced wavelength of the dihydrogen molecule H_2, involves the reduced wavelength of the Cosmic Microwave Background (CMB) $\lambdabar_{CMB} = \hbar c/kT_{CMB}$:

$$2\pi\frac{R}{\lambdabar_e} = 4\pi\frac{\lambdabar_p\lambdabar_H}{l_P^2} \approx \frac{4\pi}{3}\left(\frac{\lambdabar_{CMB}}{\lambdabar_{H_2}}\right)^3 , \tag{33}$$

leading to $T_{CMB} \approx (8G\ \hbar^4/3\lambdabar_p^5)^{1/3}/k \approx 2.729$ Kelvin, which is once more, apart the holographic factor 8/3, a c-free three-fold (Mass, Length, Time) dimensional analysis, giving the energy kT_{CMB} from the constants $G, \hbar, \lambdabar_p$. Moreover, by substituting $a_G = R/2\lambdabar_e$ with the above Lucas Number N_L, this leads to a new holographic expression (analog to the area of a 4D sphere), which gives T_{CMB}, compatible with the measured value 2.7255(6) Kelvin, which defines a mammal temperature $T_{mm} = jT_{CMB} \approx 310.50\ K = 37.350°$ C , with $j = 8\pi^2/\ln 2$ [34], with dramatic connections involving T_{H_2O}, $\lambdabar_W$ and $\lambdabar_Z$:

$$\begin{aligned}
&N_L \approx 2\pi^2\lambdabar_{CMB}^3/\lambdabar_e\lambdabar_H^2 \quad \Rightarrow \quad T_{CMB} = hc/k\lambda_{CMB} \approx 2.7258205 \text{ Kelvin}\\
&\sqrt{R_{hol}l_P} \approx \lambda_{H_2O} \quad ; \quad \sqrt{Rl_P} \approx (p/H)\lambda_{CMB}/(j+1) \qquad (20 \text{ ppm})\\
&R \approx (32\beta^2/\pi^3)\lambdabar_{CMB}^3/\lambdabar_Z^2 \quad (1.5 \text{ ppm})\\
&\lambdabar_{CMB}^3/\lambdabar_W\lambdabar_Z \approx (R_{hol}/2\beta^2)^2/N_L\lambdabar_e \quad (0.6 \text{ ppm})
\end{aligned} \tag{34}$$

The standard Cosmology predicts a Neutrino background with temperature $T_{CNB} = T_{CMB}/(4/11)^{1/3} \approx 1.946$ Kelvin. The total CMB photon number is $n_{ph} = (\xi(3)/\pi)(R/\lambdabar_{CMB})^3$, exceeding the total Hydrogen number $n_H = M/m_H = R\lambda_H/2l_P^2$. But, in term of energy, the matter dominates. So one must consider also the ratio between the critical energy density $u_{cr} = 3c^4/8\pi GR^2$ and the total background energy density $u_{cmb+cnb} = y\ u_{cmb}$, with $y = 1 + (21/8)(4/11)^{4/3} \approx 1.681322$ [44] and $u_{cmb} = (\pi^2/15)\ \hbar c/\lambdabar_{CMB}^4$. We observed that these ratios are tied by an Eddingon's type relation [38]:

$$(2n_{ph}/n_H)^{1/2} \approx u_{cr}/u_{cmb+cnb} \Rightarrow \quad T_{CMB} \approx 2.724 \text{ Kelvin} . \tag{35}$$

This confirms the existence of the Neutrino background. Now assuming that the total background Photon + Neutrino is the result of an on-going Hydrogen-Helium transformation, producing $e_{He} = 6.40 \times 10^{14}$ Joule by kilogram of Helium, i.e. an efficiency $\epsilon_{He} = e_{He}/c^2 \approx 1/140$. The Helium mass density is $Y \times \rho_{bar}$; with the standard evaluation of baryonic density $\epsilon_{bar} = \rho_{bar}/\rho_{cr} \approx 0.045$ and $Y \approx 0.25$ [1], this leads to :

$$(\lambdabar_{CMB}^2/l_PR)^2 \approx 8\pi^3 y/45Y\epsilon_{bar}\epsilon_{He} \approx 1.15\times 10^5 \ \Rightarrow\ T_{CMB} \approx 2.70 \text{ Kelvin}. \tag{36}$$

In the standard model, the Universe age in far too small to explain a large Helium large density resulting from stellar activities [8]. Thus, it is not a real problem in the steady-state model.

6 The Electron and the Kotov Non-Local Period

This study confirms the central role of $\lambdabar_e$, the unit length in the Topological Axis and in the Single Electron Universe [34]. So we look for a Diophantine series giving it for n = 1. This means:

$$\lambdabar_e \equiv \hbar/m_e c = \hbar^2/G m_G m_\hbar^2 \quad \Rightarrow \quad A \equiv m_P^2/m_G m_\hbar = m_\hbar/m_e \tag{37}$$

so that the fundamental (n = 1) energy is: $E \equiv m_\hbar c^2/A^2 = m_e c^2/A$. There is an *elimination of* c by considering the term A^2 as the product of the above gravitational constant $a_G = \hbar c/G m_p m_H$ and the electro-weak one $a_w = \hbar^3/c G_F m_e^2$ [9], where G_F is the Fermi constant:

$$A^2 = a_G a_w \qquad \Rightarrow \qquad E = m_e c^2/\sqrt{a_G a_w} \tag{38}$$

with $t_e \equiv \hbar/m_e c^2$ the electron period, this corresponds to the time:

$$t_e\sqrt{a_G a_w} \approx 9600.60\ s\ . \tag{39}$$

The identification with the Kotov P_0 period $t_K \approx 9600.606(12)$ s [19], [20] corresponds to $G \approx 6.6754527$ SI, specified to 10^{-8} by the above Single-Electron Radius $R_1 \approx (4\pi p/p_W)^2 a_w c t_K$ [36] and consistent with the BIPM measurements [29], but at 6 σ from the official value, an unusual mean between *discordant* measurements. With the Fermi mass $m_F = m_e\sqrt{a_w}$, close to the mean nucleotide mass [34], the Lepton Mu mass m_μ, $u = R_{hol}/R$, the critical density $\rho_{cr} = 3c^2/8\pi G R^2$, and $m_{GF} = (m_P m_F)^{1/2}$, this defines our optimal strong coupling a_s, in the natural process of optimal correlations [39], where $\pi_{\tau/\mu} = 3 + (7 + \mu/\tau)^{-1}$, $1/g_0 = 1 + g_1^2 + g_2^2 \approx p p_G/2a^3$, with $g_1 = Z sin\theta/H^{(0)}$, $g_2 = W/H^{(0)}$ [36]:

$$\begin{aligned}
& m_G = m_e m_p m_H/m_F^2 \quad ; \quad \sqrt{G G_F} \equiv (\ \hbar/m_{GF})^2 = (\ \hbar/\sqrt{m_p m_H})(\lambdabar_e^2/t_K) \\
& m_\hbar/m_P = m_F/\sqrt{m_p m_H} \equiv m_\mu^2/m_e m_N \equiv 2\pi a_s m_p m_H/m_e m_F \\
& G_F/G m_P^2 l_P^2 \approx a^4 m_P m_\mu/m_e^2 \ \ (0.2\%)\ ; \ \ \sqrt{p_W/n_t}\lambdabar_e^5/l_P^3(2\pi)^2 R c t_K \quad (0.8\text{ ppm}) \\
& \hbar/(G_F\,\rho_{cr})^{1/2} \approx \lambdabar_e^2/u^{1/16} l_P \ \ (0.01\%)\ ; \ (4\pi_q/3)(a a_w)^3 \approx 4\pi_{\tau/\mu}(r_e/l_P)^2 \\
& \qquad \frac{(Z/H^{(0)})^2}{1/g_0 - 1} \approx \frac{(a/137\sqrt{\beta})^4}{\pi_q/\pi} \approx 0.4ppm \ \ (3ppb)
\end{aligned} \tag{40}$$

exhibiting a symmetry between canonical area speeds. Note that $2\,ct_K \approx L_{SNL}(m_{bc})$, confirming once more the bi-codon mass, which enters also a relation involving the Cosmos, the Photon and Graviton masses [36] (Table 3). Moreover, with the precise variant (0.14 ppm) of the Golden Number: $\Phi_0 = P/(a_w H)^3 \approx ((4\pi/3)(H/p)^2)^{1/3}$, one observes (15 and 74 ppm) :

$$\begin{aligned}
\frac{L_{SNL}(m_{GF})}{r_{HB}} &\equiv \left(\frac{P}{F^3}\right)^{1/2}\frac{1}{a} \approx \Phi_0^2 \\
cT_{SNL}(m_{GF}) \equiv l_P\left(\frac{P}{F}\right)^{5/2} &\approx \left(\frac{R_{hol}\,\lambdabar_e}{2}\right)^{1/2}\frac{1}{d_e^2}
\end{aligned} \tag{41}$$

This specifies the holographic relations $a^2 \approx (4\pi/3)p^{3/2}$ and $F^5/Pa^3 \approx \eta$, with $\eta = 1 + 2/(3 \times 139)$ (ppb precision) [37], where 139 is the complete Atiyah form [2], adding the dimensions of the four algebra (octonion, quaternion, complex, real): $139 = 137 + 2 = 2^7 + 2^3 + 2^1 + 2^0 \approx i^{-i\pi}$, and $3 \times 139 + 2 = 419$, the positive crystallographic number [41] in the superstring dimensions 10D and 11D [31], see Table 7 in [37]. Moreover, $T_{SNL}(m_{GF}) \approx 19.14$ ms, typical of the Human nervous system, and the third octave down the flat La tone (Lab) for $La_3(A_4) = 442.9$ Hz, an anthropic argument far more pertinent and precise than the rough standard ones, principally based on a *cosmic Big Bang scenario* [9].

7 Discussion

The Pythagoras Principle stating that all is ruled by whole numbers has been forgotten during centuries. This resulted in the failure of Poincaré to resolve the apparently most difficult problem of modern physics, the apparition of quanta [27]. He ought to have remember that the more difficult is a problem, the more basic feature must be revisited, in particular the Kepler laws, leading to an *elementary* Diophantine equation, of trivial resolution, which implies directly an angular momentum quantum, identifiable with the reduced Planck's constant $\hbar$. Interestingly enough, in the same London conference (p. 102-103), Poincare explained that cosmology cannot be entirely founded on differential equations. Since the main scientific criteria is the repeatability of experiments, this implies the Perfect Cosmological Principle founding the steady-state model [6], and Poincaré could have concluded that cosmology, hence the whole physics, must be tied to the Number Theory [37].

This approach leads to the Diophantine Coherence Theorem (DCT) which has the same structure than the Hass formulation for the Hydrogen atom spectrum problem. This shows that the real invariant quantity is the Frequency, so that the Energy conservation would mean a Frequency Accordance, or "Coherence Principle", mandatory in Practical Holography, and conform with the Harmony Principle of Pythagoras, the father of Natural Philosophy, the very root of Science. This confirms the pertinence of the Quantum Field Theory, where any Particle Field is defined by a whole number, entering the Holographic principle in the revisited critical steady-state Universe. In particular, both the Electron Quantum Number n_e and the Neutron Quantum Number n_t play a central role. The Universe Length Quantum (Topon) is associated to a Universe Time quantum ("Chronon" $t_M = \lambda\!\!\!^{-}_M/c$), which may be looked as the period of the *Permanent Bang matter-antimatter oscillation* [35].

Among the two main cosmological models, the steady-state one is by far the most easily refutable, so the most scientific, in the Popper sense [28]. It is why it was thought as being refuted by hasty observations, however these so-called refutations were much debated [21]. *This article firmly re-establishes the steady-state cosmology. It is now mandatory to measure more precisely the Universe Temperature at any distance, in order to compare it with the microwave background one.* The galaxy recession means not at all an Universe expansion : it has been shown that the repulsive force explains at last the acceleration of the galaxy recession, the so-called "dark energy" being a trivial problem, resolved by simply considering the no-relativistic potential and kinetic galaxy population energy. This repulsive force exceeds the Newtonian attraction for larger distances than a million years, typical of a galaxy group, which shows no internal recession [36], and the renewal of matter inside such a group could be attributed to the giant black holes.

The Cosmic Length Quantum breaks the "Planck wall" by the factor 10^{-61}. The DCT shows that the Haas-Bohr radius is a *secondary* length quantum, while the Universe itself appears as a ternary length quantum in the Cosmos, defined by the Holographic Principle where the Planck length is an intermediate holographic length, instead of the standard Length quantum. The unifying length quantum is the reduced Electron Wavelength which shows up in the DCT, the Single Electron Model and the Cosmos-Universe MLT Formula.

The Kotov non-local period induces a symmetry between gravitation and electroweak interaction. The Kotov-Lyuty *Non-Doppler oscillation* plays a central role, but was overlooked : it is however a clear sign of the non-local character of Quantum Cosmology which is patent in the Foucault pendulum. *It is mandatory to check the Lyuty Non-Doppler Quasar measurements* [19]. The standard speed limit c excludes any explanation of the wave packet reduction phenomena, which requires a non-local or tachyonic Physics. So, it is logical that the bosonic string theory, which introduces tachyon, is confirmed by the Diophantine Topological Axis. Indeed, the central bosonic dimension $d = 26$ corresponds unambiguously to the non local universe whose radius is given by the Machian Formula (23).

The Planck mass enters naturally in the DCT, while incompatible with the standard in Particle Physics. However, the standard spin formulation rejoins our conclusion that the reduced Planck constant $\hbar$ plays a more fundamental role than h.

8 Conclusions

On the basis of the invariance of physical laws, the Mach Principle cannot enter an evolutionary Universe, so only the steady-state model is really compatible with scientific cosmology [6].

The invariant Universe radius is tied to 33 formula in the Table 3, whose 22 are in the 10^{-4} precision defining $R \approx 13.812$ Glyr, in the same way that Jean Perrin [24] collected 14 formula to demonstrate definitely the atom existence. This is *an historical parallel between the quantification of matter and the quantification of space-time*, a complete rehabilitation of the historical numerical empirical method, which has been greatly overlooked by an excess of formalism.

The International System must come back the three basic units (instead of seven) : Mass, Length, Time. Also, it must define electronic units by using only the electrical constant a. In particular, Particle Physics must suppress the use of eV unit, and Astrophysics suppress the Parsec unit. Also the two intercorrelated measures, the non-local Kotov-Lyuty period and G, *whose standard value is now erroneous by 6* σ must be revisited.

The Quantum Physics is not separated from Cosmology, which gets definitely the status of a real science. The object "Universe" is well defined : inside an external Cosmos, it is both a mono-atomic star, a quasi-homogeneous black hole, a gravitational molecule, a nuclear fusion reactor, a thermal machine and a particle, the ultimate gauge boson, as shown by the Topological Axis. The latter rehabilitates the bosonic string theory, but *the connection with the Periodic Table* must be explained [37].

This is a decisive confirmation of the Holographic Principle, including canonical deviations from the mathematical π, including the one associated to the electrical charge. Also the DNA bi-codon mass is central, so the DNA could be an helix-hologram, opening the way towards bio-computing [25].

The c-free Elementary Non-Local Three Minutes Formula giving the Universe half-radius is now fully established: *this means a tight harmony between the Universe and Human Consciousness, a special and decisive manifestation of the real Permanent Anthropic Principle.*

Acknowledgements

The authors are indebted to the philosophers Dominique Tassot and Nadia Guemidi, the computer scientists Laurent Gueroult, Denis Gayral and Joël Croissant, and the mathematicians Jacques Bailhache, Jacques de Wiele and Alain Molinier for useful discussions.

Submitted on April 16, 2022 / Accepted on ...

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Table 1: Physical constants

Physical Quantity	Symbol and Value	Unit	ppb (10^{-9})
Optimal Gravitation Constant [36]	$G \approx 6.67545272 \times 10^{-11}$	$kg^{-1}m^3s^{-2}$	
BIPM Gravitation Constant [29]	$6.67545(18) \times 10^{-11}$	$kg^{-1}m^3s^{-2}$	2.7×10^3
Official Gravitation Constant	$6.674\,30(15) \times 10^{-11}$	$kg^{-1}m^3s^{-2}$	1.7×10^6
Planck constant $h = 2\pi\ \hbar$	$h \approx 6.626\,070\,15 \times 10^{-34}$	J s	exact
Optimal Fermi Constant	$G_F \approx 1.435\,850\,991 \times 10^{-62}$	J m^3	
Speed of light in vacuum	$c = 299\,792\,458$	m s^{-1}	exact
Electrical Constant	$a \approx 137.035999084(21)$	-	0.15
Single Electron Universe radius	$R_1 \approx 1.492\,365\,473 \times 10^{26}$	m	
Electron Excess Magnetic moment	$d_e \approx 1.00115965218096$	-	0.26
Electron mass	$m_e \approx 9.109\,383\,7015 \times 10^{-31}$	kg	0.3
Electron Classical Radius $r_e = \lambda\!\!\!^{-}_e/a$	$r_e \approx 2.817\ 940\ 322 \times 10^{-15}$	m	0.3
Planck/Electron mass ratio $P = m_P/m_e$	$P \approx 2.389\,015\,08 \times 10^{22}$	-	
Reduced Electron Wavelength $\lambda\!\!\!^{-}_e = \hbar/m_e c$	$\lambda\!\!\!^{-}_e \approx 3.861\,592\,675 \times 10^{-13}$	m	0.3
Proton/Electron mass ratio $p = m_p/m_e$	$p \approx 1836.152\,673\,43$	-	0.06
Wyler Proton/Electron mass ratio $p_W = 6\pi^5$ [43]	$p_W \approx 1836.118019$	-	exact
Neutron/Electron mass ratio $n_t = m_n/m_e$	$n_t \approx 1838.683\,661\,7$	-	0.5
Hydrogen/Electron mass ratio $H = m_H/m_e$	$H \approx 1837.152\,660\,14$	-	0.06
Hydrogen correction factor $\beta = 1/(H-p)$	$\beta \approx 1.0000266$	-	
Opt. Weak Coupl. Ct. $a_w = F^2 = \hbar^3/cG_F m_e^2$ [37]	$a_w \approx 3.283374406 \times 10^{11}$	-	
Official Strong Coupling constant	$a_s \approx 8.48(7)\ (8)$	-	7.6 $\times 10^6$
Optimal Strong Coupling Constant [37]	$a_s \approx 8.434502914$	-	
Optimal Muon/Electron mass rat. $\mu = m_\mu/m_e$ [36]	$\mu \approx 206.768\,286\,9$	-	
Optimal Tau/Electron mass rat. $\tau = m_\tau/m_e$ [36]	$\tau \approx 3477.441\,701$	-	
Opt. Higgs Boson mass ratio $H^{(0)} = m_{Hgs}/m_e$ [37]	$H^{(0)} \approx 495^2$	-	
W-boson mass ratio $W = m_W/m_e$	$W \approx 157340.1093$	-	
Z-boson mass ratio $Z = m_Z/m_e$	$Z \approx 178451.7529$	-	
Adimens. El. Charge $q = W sin\theta/H^{(0)} = \sqrt{4\pi_q/a}$	$q \approx 0.302\ \ 973\ 2863$	-	
Boltzmann Constant (conversion factor)	$k = 1.38064910^{-23}$	J K^{-1}	exact
Measured CMB temperature	$T_{CMB} \approx 2.725\,5(6)$	Kelvin	
Optimal CMB Temperature	$T_{CMB} \approx 2.725\,820\,138$	K	
Optimal CMB Wien wavelength	$\lambda_{Wn} \approx 1.063\,082\,472 \times 10^{-3}$	m	
Optimal CMB reduced wavel. $\lambda_{CMB} = \hbar c/kT_{CMB}$	$\lambda_{CMB} \approx 8\,400\,716\,617 \times 10^{-4}$	m	
Optimal CNB Temp. $T_{CNB} \equiv T_{CMB}(11/4)^{-1/3}$	$T_{CNB} \approx 1\,945\,597$	K	
Water Triple Point Temperature	$T_{H_2O} \approx 273.16$	K	
Optimal critical density $\rho_{cr} = 3c^2/8\pi GR^2$	$\rho_{cr} \approx 9.411\,979\,89\ \times 10^{-27}$	kg $m^{-1/3}$	
Kotov P_0 period t_K	$t_K \approx 9600.606(12)$ [20]	s	1200

Table 2: Values of the DCT Fundamental (n = 1) Radius $\hbar^2/Gm_Gm_\hbar^2$ for specific values of m_G and $m_\hbar$. Holographic ratio $u = R_{hol}/R\ approx 14.310\ 841\ 007$. Nambu mass : $m_N = am_e$. Bicodon mass $m_{bc} = m_pm_H/m_e$. Photon mass $m_{ph} = \hbar/c^2t_K \approx 1.2222 \times 10^{-55}$ kg. Graviton mass : $m_{gr} = m_{ph}/a_w \approx 3.7223 \times 10^{-67}$ kg [36].

m_G	$m_\hbar$	Length	Symbol	Precision/offset
m_P^2/m_N	m_P^2/m_N	Cosmic Space Quantum	d_0	exact
m_P^2/m_0	m_P^2/m_0	Universe Space Quantum (Topon)	$\lambda\!\!\!^-_M$	exact
m_{bc}/a_w	$m_e\sqrt{a_wa_G}$	Reduced Electron Wavelength	$\lambda\!\!\!^-_e$	exact
m_P^2/m_N	m_e	Hass-Bohr radius $r_{HB} = a\lambda\!\!\!^-_e = r_B/(1+1/p)$	r_{HB}	exact
a^3m_P	$\sqrt{m_pm_H}$	Background Wien Wavelength	λ_W	3.2×10^{-4}
m_{bc}	m_{bc}	Twice Kotov Length	$2l_K$	6.3×10^{-3}
m_{Hg}	m_{Hg}	$R\lambda\!\!\!^-_e/4\lambda\!\!\!^-_{CMB}$ RF/WZ^2		- 0.23 % + 0.25 %
m_{bc}	m_e	Half Universe Radius	$R_{H_2} \equiv R/2$	exact
m_N	m_N	Half Holographic Cosmos radius	$R_{hol}/2$	exact
m_N^2/m_P	m_N^2/m_P	Half Cosmos Radius	$R_C/2$	exact
$u \times m_{bc}$	$\sqrt{m_{ph}m_{gr}}$	Cosmos radius	R_C	1.7×10^{-3}

Table 3: Implication of Eddington Number ($N_E = 136 \times 2^{256}$) and Holophysics formula for the *invariant* Hubble radius $R \approx 13.812$ Giga light-year (Gly = 1 billion light- Julian year, 365.25 days) and the corresponding Hubble constant $H_0 = c/R$, which uses the length unit Megaparsec, compared to the main measurements. Lucas Number $N_L = 2^{127} - 1$. Topological Function $f(k) \equiv e^{2^{k+1/2}}$. Holographic ratio $u = R_{hol}/R$. Mammal temperature $T_{mm} \equiv hc/k\lambda_{mm} = jT_{CMB}$, with $j = 8\pi^2/ln2$ [34]. The optimal WZ value (Table 1) is defined from the identification to the Central Formula R = 2 $\times$ gravitational H_2 radius, which is also 2 $\times$ the "Three Minutes Formula" (closed draft 1998) where the neutron mass is replaced by the hydrogen mass. The last Euler idoneal number is $s_{65} = 1848$. For comparison, the so-called standard "Universe Age" is also presented, with unit in the c ratio (Gyr = 1 billion year).

Date	Source $R = 2GM/c^2$	Hubble radius Glyr	Hubble Cst. km s^{-1}/Mpc	Univ. "Age" Gyr
1945	Eddington Nb. N_E [11] ; $N_E \approx (3/10)Mm_p/m_H m_n$	13.812	70.793	
1927	Lemaître [22]	1.6	620	
1929	Hubble [17]	1.8	540	
1956	Humason, Maydal and Sandage [18]	5.4	180	
1958	Sandage [40]	13	75	
1998	$2\ \hbar^2/Gm_e m_p m_n$ TWICE "3 MN FORMULA"	13.800	70.852	
2006	$2\ \hbar^2/Gm_e m_p m_n$ [33]	13.800	70.852	
2006	$2\ N_L \lambda\!\!\!^{-}_e$ [33]	13.889	70.400	
2017	$(WZ)^4(\lambda\!\!\!^{-}_p \lambda\!\!\!^{-}_H)^{1/2}$ [9] [34]	13.812	70.793	
2017	$\lambda\!\!\!^{-}_e f(6)/6$ [34]	13.821	70.747	
2017	$(2\ \lambda\!\!\!^{-}_e/3)\ (\lambda_{CMB}/\lambda_{H_2})^3$ [34] Holography Eq. (30)	13.897	70.360	
2017	$\lambda\!\!\!^{-}_e(3^3)^{3^3}/u$ [34] From $R_{hol}/\lambda\!\!\!^{-}_e \approx (3^3)^{3^3}$	13.812	70.796	
2017	$2\ \hbar^2/Gm_e m_p m_H$ [34] MACHIAN FORMULA	13.812	70.793	
2017	$(32\beta^2/pi^3)\ \lambda\!\!\!^{-}_{CMB}^3/\lambda\!\!\!^{-}_Z^2$ From Eq. (31)	13.812	70.793	
2017	$(2\beta^2/u)(N_L \lambda\!\!\!^{-}_e \lambda\!\!\!^{-}_{CMB}^3/\lambda\!\!\!^{-}_W \lambda\!\!\!^{-}_Z)^{1/2}$ From Eq. (31)	13.812	70.793	
2017	$2(ct_K)^2/a_w \lambda\!\!\!^{-}_e$ [34] Non-Local Oscillation	13.812	70.793	
2017	$\lambda\!\!\!^{-}_e(H/p_W)(2\pi^2 a^3)^5$ [34] Holic Principle	13.812	70.793	
2017	$(hc/kT_{H_2O})^2/ul_P$ [34] From $\sqrt{R_{hol} l_P} \approx \lambda_{H_2O}$	13.840	70.650	
2017	$((H/p)(1+1/j)\lambda_{mm})^2/l_P$ From Eq. (31)	13.812	70.793	
2017	$\sqrt{n_t/p_W}\lambda\!\!\!^{-}_e^5/al_P^3 ct_K$ From Eq. (37)	13.812	70.793	
2019	$\lambda\!\!\!^{-}_e\ (2/u)^{2\times3\times5\times7}$ [36] Complete Holic Principle	13.856	70.568	
2021	$\lambda\!\!\!^{-}_e\ (6/\pi)^{r_B/\lambda\!\!\!^{-}_e}$ [37]	13.776	70.978	
2021	$\lambda\!\!\!^{-}_e\ (n_t/p)^{1/2}\pi^{5\times31/2}$ [37]	13.812	70.796	
2021	$\lambda_p\ (d_e/2)(pH)^{3a_s/4}$ [37]	13.812	70.793	
2021	$2\lambda\!\!\!^{-}_e((1837+s_{65})/2+1)^{\sqrt{a}}$ [37] $s_{65} = 1848$	13.812	70.793	
2021	Cosmos-Universe Couple MLT Formula (28) [37]	13.726	71.276	
2022	$(3R_{hol}\lambda\!\!\!^{-}_{CNB}^4/\lambda\!\!\!^{-}_e^3)^{1/2}$	13.832	70.772	
2022	$\lambda\!\!\!^{-}_e(a-136)^{1/2}(e^{e^e})^{\sqrt{a}/2}$	13.814	70.783	
2022	$(2\pi/3)(H/p)\lambda\!\!\!^{-}_e p^{\sqrt{a}}$	13.812	70.793	
2022	$(1+1/a)^6\lambda\!\!\!^{-}_e^5/18a_w N_L l_P^4$ From Eqs. (13, 29)	13.812	70.793	
2022	$R_1^2 N_L l_P^2 p_W^2/R_{hol}\lambda\!\!\!^{-}_e^2\beta$ From $R_1 \approx (RR_{hol})^{1/2}$	13.812	70.793	
2022	$2R_1^2/a_w^3(4\pi p/p_W)^4$ From $R_1 \approx ct_K a_w(4\pi p/p_W)^4$	13.812	70.793	
2022	$N_L(4\pi)^4 a_w^3(137/a)^2/R_{hol}$	13.812	70.793	
2022	$(N_L/u)(2^7/3)a_s/(a+1)$	13.812	70.793	
2022	$(N_L/u)(2^7/3)a_s/(a+1)$	13.812	70.793	
2022	$(2H/p)\lambda\!\!\!^{-}_e Z^7$	13.812	70.793	
2022	$\lambda\!\!\!^{-}_p(\lambda\!\!\!^{-}_p/\lambda\!\!\!^{-}_n)(32)^a$	13.812	70.793	
2022	$2N_L\lambda\!\!\!^{-}_e(1-(137^2+\pi^2+e^2)/pH)$ From ppb Eq. (27)	13.812	70.793	
1998	PDG (Particle Data Group)	14 ± 2	70 ± 10	11.5 ± 1.5
2002	PDG	13.7 ± 0.3	71 ± 3	15 ± 3
2005	Hubble Space Telescope	13.6 ± 1.5	72 ± 8	13.7 ± 0.2
2012	WMAP [5]	14.1 ± 0.2	69.3 ± 0.8	13.77 ± 0.06
2019	Riess group [30]	13.2 ± 0.3	74.2 ± 1.4	
2020	Planck mission [1]	14.5 ± 0.1	67.4 ± 0.5	13.82 ± 0.04
2020	HOLICOW [42]	13.4 ± 0.3	73.3 ± 1.8	
2021	Carnegie-Chicago Hubble Program [14]	14.0 ± 0.3	69.8 ± 1.6	