Programming Mass, Space and Time within a Computer Simulated Universe

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In this article I describe 1 potential method for programming the base Planck units of mass, length, time, charge and temperature within in a simulated universe. I use a virtual electron model which embeds these base units as simple geometrical forms (mass M=1, time T=2π, length L=$2\pi^2\Omega^2$ ...). It is the geometry which incorporates the functionality of the unit, thus resolving the principal difficulty of mathematical universe hypotheses as being how to relate mathematical forms to corresponding physical entities. I then demonstrate how these geometries can be used to solve the principal dimensioned physical constants G, h, c, e, m_e, k_B using 2 mathematical constants (fine structure constant alpha and a recurring number Omega) and 2 scalars. The 5 SI units kg, m, s, A, k are reduced to exponents of a single unit u. As these constants and units are mathematical objects they may be reproduced algorithmically within a simulation environment.

Table 1	Calculated	CODATA 2014
Fine structure constant alpha	(137.035999 139)	α = 137.035 999 139(31) [18]
Rydberg constant	(10973731.568 508)	R_∞ = 10 973 731.568 508(65) [15]
Planck constant	h^* = 6.626 069 134 e-34	h = 6.626 070 040(81) e-34 [16]
Elementary charge	e^* = 1.602 176 511 30 e-19	e = 1.602 176 6208(98) e-19 [19]
Electron mass	m_e^* = 9.109 382 312 56 e-31	m_e = 9.109 383 56(11) e-31 [17]
Boltzmann's constant	k_B^* = 1.379 510 147 52 e-23	k_B = 1.380 648 52(79) e-23 [22]
Gravitation constant	G^* = 6.672 497 192 29 e-11	G = 6.674 08(31) e-11 [21]

keywords: mathematical universe, simulated universe, Planck unit theory, virtual universe, magnetic-monopole, fine structure constant alpha, Omega, black-hole electron, sqrt Planck momentum;

1 Background

The general universe simulation hypothesis proposes that all of reality, including the earth and the universe, is in fact an artificial simulation, analogous to a computer simulation, and as such our reality is an illusion. The ancestor simulation hypothesis suggests that later generations might, with their super-powerful computers, run detailed simulations of their forebears. In this limited version simulating the entire universe down to the quantum level is obviously infeasible, it is sufficient to merely ensure that the simulated humans, interacting in normal human ways with their simulated environment, don't notice any irregularities [2].

Mathematical platonism is a metaphysical view that there are abstract mathematical objects whose existence is independent of us [1]. Mathematical realism holds that mathematical entities exist independently of the human mind. Thus humans do not invent mathematics, but rather discover it. Triangles, for example, are real entities, not the creations of the human mind [3].

Max Tegmark's Mathematical Universe Hypothesis: Our external physical reality is a mathematical structure. That is, the physical universe is mathematics in a well-defined sense, and "in those [worlds] complex enough to contain self-aware substructures [they] will subjectively perceive themselves as existing in a physically 'real' world" [10].

Planck units are a set of units of measurement also known as natural units because the origin of their definition comes only from properties of nature and not from any human construct. The base units are Planck mass, Planck time, Planck length, Planck charge, Planck temperature.

2 Introduction

Mathematical universe hypotheses presume that our physical universe has an underlying mathematical origin. The principal difficulty of such hypotheses is the problem of constructing physical units such as mass, space and time from mathematical objects.

The simulated universe model of this article is a mathematical universe model that uses geometrical objects to duplicate the functionality of the unit. These geometrical objects are constructed from 2 mathematical constants; the fine structure constant α and a presumed constant Ω. The 5 SI units kg, m, s, A, k are replaced by a single unit u. To solve the physical constants G, h, c, e, m_e, k_B in SI terms also requires 2 scalars to convert from the base geometries to their respective SI values. Results are consistent with CODATA 2014 (see table).

Geometries (mass M=1, time T=2π, length L=$2\pi^2\Omega^2$ ...) are embedded within a virtual electron $f_e = 4\pi^2(2^6 3\pi^2\alpha\Omega^5)^3$, units = 1. As these geometries overlap in the electron our mass, space and time are not independent of each other, and so we can for example create mass as long as we create the equivalent space and time to balance our electron; i.e.: the sum remains units = 1.

This also means that I can define mass in terms of space and time.

Thus I offer that it is possible to duplicate the physical units of mass, space, time and charge using mathematical forms and that these forms, being geometrical, can be represented algorithmically within a simulation of a virtual universe.

In section 3. I introduce the rationale for a virtual electron. In section 4. I use this electron to construct those geometrical forms.

3 A virtual electron

In this section I introduce the sqrt of momentum and suggest how this could be used as a link between the mass and charge domains such that we can then reduce the number of required SI units as the ampere A and temperature k can be replaced.

From the formulas for the charge constants I then derive a formula for a magnetic monopole (ampere-meter AL) and from this subsequently a formula for an electron f_e.

The electron formula is constructed from monopoles (AL) and from time T yet it is also a dimensionless mathematical constant, a virtual electron. I conjecture that this is possible if the charge and time units are not independent but rather are related, overlapping and collapsing within the electron whereby; $f_e = (AL)^3/T$, units = 1.

By reducing the number of physical units, it becomes possible to redefine the less precise of the physical constants G, h, c, e, m_e, k_B in terms of the 4 most precise c, μ_0 (exact values), Rydberg R (12 digit precision) and α (10 digit precision). See table p1.

Note: for convenience I use the commonly recognized value for the fine structure constant as $\alpha = 137....$ although this is actually the value for α^{-1}.

Defining Q as the sqrt of Planck momentum where Planck momentum = $m_P c = 2\pi Q^2 = 6.52485...\ kg.m/s$, and a unit q whereby $q^2 = kg.m/s$ giving;

$$Q = 1.019\ 113\ 411...,\ unit = q \tag{1}$$

Planck momentum; $2\pi Q^2,\ units = q^2$,
Planck length; $l_p,\ units = m = q^2 s/kg$,
$c,\ units = m/s = q^2/kg$;

3.1. In Planck terms the mass constants are typically defined in terms of Planck mass, here I use Planck momentum;

$$m_P = \frac{2\pi Q^2}{c},\ unit = kg \tag{2}$$

$$E_p = m_P c^2 = 2\pi Q^2 c,\ units = \frac{kg.m^2}{s^2} = \frac{q^4}{kg} \tag{3}$$

$$t_p = \frac{2l_p}{c},\ unit = s \tag{4}$$

$$F_p = \frac{2\pi Q^2}{t_p},\ units = \frac{q^2}{s} \tag{5}$$

3.2. The charge constants in terms of Q^3, c, α, l_p;

$$A_Q = \frac{8c^3}{\alpha Q^3},\ unit\ A = \frac{m^3}{q^3 s^3} = \frac{q^3}{kg^3} \tag{6}$$

$$e = A_Q t_p = \frac{8c^3}{\alpha Q^3}.\frac{2l_p}{c} = \frac{16 l_p c^2}{\alpha Q^3},\ units = A.s = \frac{q^3 s}{kg^3} \tag{7}$$

$$T_p = \frac{A_Q c}{\pi} = \frac{8c^3}{\alpha Q^3}.\frac{c}{\pi} = \frac{8c^4}{\pi \alpha Q^3},\ units = \frac{q^5}{kg^4} \tag{8}$$

$$k_B = \frac{E_p}{T_p} = \frac{\pi^2 \alpha Q^5}{4c^3},\ units = \frac{kg^3}{q} \tag{9}$$

3.3. As with c, the permeability of vacuum μ_0 has been assigned an exact numerical value so it is our next target. The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to exactly 2.10^{-7} newton per meter of length.

$$\frac{F_{electric}}{A_Q^2} = \frac{F_p}{\alpha}.\frac{1}{A_Q^2} = \frac{2\pi Q^2}{\alpha t_p}.(\frac{\alpha Q^3}{8c^3})^2 = \frac{\pi \alpha Q^8}{64 l_p c^5} = \frac{2}{10^7} \tag{10}$$

$$\mu_0 = \frac{\pi^2 \alpha Q^8}{32 l_p c^5} = \frac{4\pi}{10^7},\ units = \frac{kg.m}{s^2 A^2} = \frac{kg^6}{q^4 s} \tag{11}$$

3.4. Rewritting Planck length l_p in terms of Q, c, α, μ_0;

$$l_p = \frac{\pi^2 \alpha Q^8}{32 \mu_0 c^5},\ unit = \frac{q^2 s}{kg} = m \tag{12}$$

3.5. A magnetic monopole in terms of Q, c, α, l_p;

The ampere-meter is the SI unit for pole strength (the product of charge and velocity) in a magnet ($Am = ec$). A magnetic monopole σ_e is a hypothetical particle that is a magnet with only 1 pole [12]. I propose a magnetic monopole σ_e from α, e, c ($\sigma_e = 0.13708563x10^{-6}$);

$$\sigma_e = \frac{3\alpha^2 ec}{2\pi^2},\ units = \frac{q^5 s}{kg^4} \tag{13}$$

I then use this monopole to construct an electron frequency function f_e ($f_e = 0.2389545x10^{23}$);

$$f_e = \frac{\sigma_e^3}{t_p} = \frac{2^8 3^3 \alpha^3 l_p^2 c^{10}}{\pi^6 Q^9} = \frac{3^3 \alpha^5 Q^7}{4\pi^2 \mu_0^2},\ units = \frac{q^{15} s^2}{kg^{12}} \tag{14}$$

3.6. The most precisely measured of the natural constants is the Rydberg constant R_∞ (see table) and so it is important to this model. The unit for R_∞ is $1/m$. For m_e see eq(22);

$$R_\infty = \frac{m_e e^4 \mu_0^2 c^3}{8h^3} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi \alpha^8 Q^{15}},\ units = \frac{1}{m} = \frac{kg^{13}}{q^{17} s^3} \tag{15}$$

We now have 2 solutions for length m ($m = q^2 s/kg$), if they are both valid then there must be a ratio whereby the units q, s, kg overlap and cancel;

$$m = \frac{q^2 s}{kg} . \frac{q^{15} s^2}{kg^{12}} = \frac{q^{17} s^3}{kg^{13}};\ thus\ \frac{q^{15} s^2}{kg^{12}} = 1 \tag{16}$$

and so we can reduce the number of units required from 3 to 2, for example we can define s in terms of kg, q;

$$s = \frac{kg^6}{q^{15/2}} \tag{17}$$

$$\mu_0 = \frac{kg^6}{q^4 s} = q^{7/2} \tag{18}$$

3.7. We find that this ratio is embedded in that electron function f_e (eq 14), and so f_e is a dimensionless mathematical constant whose function appears to be dictating the frequency of the Planck units;

$$f_e = \frac{\sigma_e^3}{t_p};\ units = \frac{q^{15} s^2}{kg^{12}} = 1 \tag{19}$$

Replacing q with the more familiar m gives this ratio;

$$q^2 = \frac{kg.m}{s};\ q^{30} = (\frac{kg.m}{s})^{15} = \frac{kg^{24}}{s^4} \tag{20}$$

$$units = \frac{kg^9 s^{11}}{m^{15}} = 1 \tag{21}$$

Electron mass as frequency of Planck mass:

$$m_e = \frac{m_P}{f_e},\ unit = kg \tag{22}$$

Electron wavelength via Planck length:

$$\lambda_e = 2\pi l_p f_e,\ units = m = \frac{q^2 s}{kg} \tag{23}$$

Gravitation coupling constant:

$$\alpha_G = (\frac{m_e}{m_P})^2 = \frac{1}{f_e^2},\ units = 1 \tag{24}$$

3.8. The Rydberg constant $R_\infty = 10973731.568508(65)$ [15] has been measured to a 12 digit precision. The known precision of Planck momentum and so Q is low, however with the solution for the Rydberg eq(15) we may re-write Q as Q^{15} in terms of; c, μ_0, R and α;

$$Q^{15} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi \alpha^8 R},\ units = \frac{kg^{12}}{s^2} = q^{15} \tag{25}$$

Using the formulas for Q^{15} eq(25) and l_p eq(12) we can re-write the least accurate dimensioned constants in terms of the most accurate constants; R, c, μ_0, α. I first convert the constants until they include a Q^{15} term which can then be replaced by eq(25). Setting unit x as;

$$unit\ x = \frac{kg^{12}}{q^{15} s^2} = 1 \tag{26}$$

Elementary charge e = 1.602 176 51130 e-19 (table p1)

$$e = \frac{16 l_p c^2}{\alpha Q^3} = \frac{\pi^2 Q^5}{2\mu_0 c^3},\ units = \frac{q^3 s}{kg^3} \tag{27}$$

$$e^3 = \frac{\pi^6 Q^{15}}{8\mu_0^3 c^9} = \frac{4\pi^5}{3^3 c^4 \alpha^8 R},\ units = \frac{kg^3 s}{q^6} = (\frac{q^3 s}{kg^3})^3 .x \tag{28}$$

Planck constant h = 6.626 069 134 e-34

$$h = 2\pi Q^2 2\pi l_p = \frac{4\pi^4 \alpha Q^{10}}{8\mu_0 c^5},\ units = \frac{q^4 s}{kg} \tag{29}$$

$$h^3 = (\frac{4\pi^4 \alpha Q^{10}}{8\mu_0 c^5})^3 = \frac{2\pi^{10} \mu_0^3}{3^6 c^5 \alpha^{13} R^2},\ units = \frac{kg^{21}}{q^{18} s} = (\frac{q^4 s}{kg})^3 .x^2 \tag{30}$$

Boltzmann constant k_B = 1.379 510 14752 e-23

$$k_B = \frac{\pi^2 \alpha Q^5}{4c^3},\ units = \frac{kg^3}{q} \tag{31}$$

$$k_B^3 = \frac{\pi^5 \mu_0^3}{3^3 2 c^4 \alpha^5 R},\ units = \frac{kg^{21}}{q^{18} s^2} = (\frac{kg^3}{q})^3 .x \tag{32}$$

Gravitation constant G = 6.672 497 19229 e-11

$$G = \frac{c^2 l_p}{m_P} = \frac{\pi \alpha Q^6}{64 \mu_0 c^2},\ units = \frac{q^6 s}{kg^4} \tag{33}$$

$$G^5 = \frac{\pi^3 \mu_0}{2^{20} 3^6 \alpha^{11} R^2},\ units = kg^4 s = (\frac{q^6 s}{kg^4})^5 .x^2 \tag{34}$$

Planck length

$$l_p^{15} = \frac{\pi^{22} \mu_0^9}{2^{35} 3^{24} c^{35} \alpha^{49} R^8},\ units = \frac{kg^{81}}{q^{90} s} = (\frac{q^2 s}{kg})^{15} .x^8 \tag{35}$$

Planck mass

$$m_P^{15} = \frac{2^{25} \pi^{13} \mu_0^6}{3^6 c^5 \alpha^{16} R^2},\ units = kg^{15} = \frac{kg^{39}}{q^{30} s^4} . \frac{1}{x^2} \tag{36}$$

Electron mass m_e = 9.109 382 31256 e-31

$$m_e^3 = \frac{16 \pi^{10} R \mu_0^3}{3^6 c^8 \alpha^7},\ units = kg^3 = \frac{kg^{27}}{q^{30} s^4} . \frac{1}{x^2} \tag{37}$$

Ampere

$$A_Q^5 = \frac{2^{10} \pi 3^3 c^{10} \alpha^3 R}{\mu_0^3},\ units = \frac{q^{30} s^2}{kg^{27}} = (\frac{q^3}{kg^3})^5 . \frac{1}{x} \tag{38}$$

3.9. ($r = \sqrt{q}$)

There is a solution for an $r^2 = q$, it is the radiation density constant from the Stefan Boltzmann constant σ;

$$\sigma = \frac{2\pi^5 k_B^4}{15h^3c^2},\ r_d = \frac{4\sigma}{c},\ units = r \quad (39)$$

$$r_d^3 = \frac{3^3 4\pi^5 \mu_0^3 \alpha^{19} R^2}{5^3 c^{10}},\ units = \frac{kg^{30}}{q^{36}s^5}.\frac{1}{x^2} = \frac{kg^6}{q^6 s} = r^3 \quad (40)$$

4 Geometrical constants

4.1. The formula for the electron f_e incorporates dimensionful quantities but itself is dimensionless. This means that its numerical value is a mathematical constant, independent of which set of units we may use. This also means that we can look for other sets of units which can also be used to solve f_e. In this section I construct the base units from a geometrical component in terms of 2 dimensionless mathematical constants; the fine structure constant alpha and a proposed Omega, and from 2 scalars (from $ktlvpa$) with an associated dimensionful unit u^n.

$$M = (1)k,\ unit = u^{15}\ (mass) \quad (41)$$

$$T = (2\pi)t,\ unit = u^{-30}\ (time) \quad (42)$$

$$P = (\Omega)p,\ unit = u^{16}\ (sqrt\ of\ momentum) \quad (43)$$

$$V = (2\pi\Omega^2)v,\ unit = u^{17}\ (velocity) \quad (44)$$

$$L = (2\pi^2\Omega^2)l,\ unit = u^{-13}\ (length) \quad (45)$$

$$A = (\frac{64\pi^3\Omega^3}{\alpha})a,\ unit = u^3\ (ampere) \quad (46)$$

4.2 As the scalars incorporate the unit u, we can construct a principal scalar β, unit = u. Using the SI values for a, v, p, t, k; the value of $\beta = 23326079.1$;

$$\beta;\ units = a^{1/3} = v/p = 1/(t^{2/15}k^{1/5}) = 1/(t^{1/6}p^{1/4}) = u \quad (47)$$

For example, from P, V I derive $MLTA$ and then the physical constants. Scaling p, v to their SI values gives M=m_P, L=l_p, T=t_p, V=c, P=Q

$$P = (\Omega)p,\ unit = u^{16} \quad (48)$$

$$V = (2\pi\Omega^2)v,\ unit = u^{17} \quad (49)$$

$$M = \frac{2\pi P^2}{V} = (1)\frac{p^2}{v},\ unit = u^{16*2-17=15} \quad (50)$$

$$T^2 = (2\pi\Omega)^{15}\frac{P^9}{2\pi V^{12}} \quad (51)$$

$$T = (2\pi)\frac{p^{9/2}}{v^6},\ unit = u^{16*9/2-17*6=-30} \quad (52)$$

$$L = \frac{2T}{V} = (2\pi^2\Omega^2)\frac{p^{9/2}}{v^5},\ unit = u^{16*9/2-17*5=-13} \quad (53)$$

$$A = \frac{8V^3}{\alpha P^3} = (\frac{2^6\pi^3\Omega^3}{\alpha})\frac{v^3}{p^3},\ unit = u^{17*3-16*3=3} \quad (54)$$

For convenience I assign $r = \sqrt{p}$, unit $u^{16/2=8}$;

$$G^* = \frac{V^2 L}{M} = 2^3\pi^4\Omega^6\frac{r^5}{v^2},\ u^{34-13-15=8*5-17*2=6} \quad (55)$$

$$h^* = 2\pi MVL = 2^3\pi^4\Omega^4\frac{r^{13}}{v^5},\ u^{15+17-13=8*13-17*5=19} \quad (56)$$

$$T_P^* = \frac{AV}{\pi} = \frac{2^7\pi^3\Omega^5}{\alpha}\frac{v^4}{r^6},\ u^{3+17=17*4-6*8=20} \quad (57)$$

$$e = AT = \frac{2^7\pi^4\Omega^3}{\alpha}\frac{r^3}{v^3},\ u^{3-30=3*8-17*3=-27} \quad (58)$$

$$k_B^* = \frac{\pi VM}{A} = \frac{\alpha}{2^5\pi\Omega}\frac{r^{10}}{v^3},\ u^{17+15-3=10*8-17*3=29} \quad (59)$$

$$\mu_0^* = \frac{\pi V^2 M}{\alpha L A^2} = \frac{\alpha}{2^{11}\pi^5\Omega^4}r^7,\ u^{17*2+15+13-6=7*8=56} \quad (60)$$

$$\epsilon_0^{*-1} = \frac{\alpha}{2^9\pi^3}v^2 r^7,\ u^{34+56=90} \quad (61)$$

$$r_\sigma^* = (\frac{8\pi^5 k_B^4}{15h^3c^3}) = \frac{\alpha}{2^{29}15\pi^{14}\Omega^{22}}r,\ u^{29*4-19*3-17*3=8} \quad (62)$$

$$R^* = (\frac{m_e}{4\pi l_p\alpha^2 m_P}) = \frac{1}{2^{23}3^3\pi^{11}\alpha^5\Omega^{17}}\frac{v^5}{r^9},\ u^{13} \quad (63)$$

Scalars r, v were chosen as they can be determined directly from c, μ_0 (eq 49, 60);

$$v = \frac{c}{2\pi\Omega^2} \quad (64)$$

$$r^7 = \frac{2^6\pi^6\Omega^4}{5^7\alpha} \quad (65)$$

4.3. Unit = 1 combinations (examples)

$$(\frac{r^{17}}{v^8} = \frac{u^{8*17}}{u^{17*8}}) = (k^2 t = \frac{u^{15*2}}{u^{30}}),\ units = 1 \quad (66)$$

$$M^2 = \frac{r^8}{v^2},\ unit = u^{8*8-17*2=30}\ (kg^2) \quad (67)$$

$$T^{-1} = \frac{v^6}{2\pi r^9},\ unit = u^{17*6-8*9=30}\ (1/s) \quad (68)$$

$$M^2 T = \frac{r^8}{v^2}\frac{2\pi r^9}{v^6} = 2\pi(\frac{r^{17}}{v^8}),\ unit = 1 \quad (69)$$

In SI Planck units;

$$\frac{L^{15}}{M^9 T^{11}} = \frac{l_p^{15}}{m_P^9 t_p^{11}} = \frac{(2\pi^2\Omega^2)^{15}}{(1)^9(2\pi)^{11}}.\frac{l^{15}}{k^9 t^{11}} = 2^4\pi^{19}\Omega^{30} \quad (70)$$

$$\frac{l^{15}}{k^9 t^{11}} = \frac{u^{-13*15}}{u^{15*9}u^{-30*11}} = 1 \quad (71)$$

$$\frac{A^3 L^3}{T} = \frac{A_Q^3 l_p^3}{t_p} = \frac{(2^6\pi^3\Omega^3)^3(2\pi^2\Omega^2)^3}{(\alpha)^3(2\pi)}.\frac{a^3 l^3}{t} = \frac{2^{20}\pi^{14}\Omega^{15}}{\alpha^3} \quad (72)$$

$$\frac{a^3 l^3}{t} = \frac{u^{3*3}u^{-13*3}}{u^{-30}} = 1 \quad (73)$$

The electron function f_e is both unit-less and non-scalable $v^0 r^0 u^0 = 1$. It is therefore a natural (mathematical) constant.

$$\sigma_e = \frac{3\alpha^2 AL}{\pi^2} = 2^7 3\pi^3\alpha\Omega^5\frac{r^3}{v^2},\ u^{-10} \quad (74)$$

$$f_e = \frac{\sigma_e^3}{T} = 4\pi^2(2^6 3\pi^2\alpha\Omega^5)^3,\ units = \frac{u^{30}}{(u^{10})^3} = 1 \quad (75)$$

$$\sigma_{tp} = \frac{3\alpha^2 T_P}{2\pi} = 2^6 3\pi^2\alpha\Omega^5\frac{v^4}{r^6},\ units = u^{20} \quad (76)$$

$$f_e = t_p^2\sigma_{tp}^3 = 4\pi^2(2^6 3\pi^2\alpha\Omega^5)^3,\ units = \frac{(u^{20})^3}{(u^{30})^2} = 1 \quad (77)$$

4.4. The Sommerfeld fine structure constant alpha is a dimensionless mathematical constant. The following use a well known formula for alpha;

$$\alpha = \frac{2h}{\mu_0 e^2 c} = 2.2\pi Q^2 2\pi l_p.\frac{32 l_p c^5}{\pi^2\alpha Q^8}.\frac{\alpha^2 Q^6}{256 l_p^2 c^4}.\frac{1}{c} = \alpha \quad (78)$$

$$\alpha = 2(8\pi^4\Omega^4)/(\frac{\alpha}{2^{11}\pi^5\Omega^4})(\frac{128\pi^4\Omega^3}{\alpha})^2(2\pi\Omega^2) = \alpha \quad (79)$$

$$units = \frac{u^{19}}{u^{56}(u^{-27})^2 u^{17}} = 1 \quad (80)$$

4.5. I have also premised a 2nd mathematical constant which I have denoted Omega. We can find a numerical solution using the precise c^*, μ_0^*, R^*;

$\Omega = 2.0071349496...$;

$$\frac{(c^*)^{35}}{(\mu_0^*)^9(R^*)^7},\ units = \frac{(u^{17})^{35}}{(u^{56})^9(u^{13})^7} = 1 \quad (81)$$

$$\frac{(c^*)^{35}}{(\mu_0^*)^9(R^*)^7} = (2\pi\Omega^2)^{35}/(\frac{\alpha}{2^{11}\pi^5\Omega^4})^9.(\frac{1}{2^{23}3^3\pi^{11}\alpha^5\Omega^{17}})^7 \quad (82)$$

$$\Omega^{225} = \frac{(c^*)^{35}}{2^{295}3^{21}\pi^{157}(\mu_0^*)^9(R^*)^7\alpha^{26}},\ units = 1 \quad (83)$$

There is a close sqrt natural number solution for Ω;

$$\Omega = \sqrt{\left(\frac{\pi^e}{e^{(e-1)}}\right)} = 2.0071\ 349\ 5432... \quad (84)$$

$\Omega^{(15)n}$ apparently can have a 'buffer' role. As units (of the series) $u^{15}, u^{30}, ..., u^{90}$ have no Ω, this suggests a base structure. Here I expand β (eq 47) to include an Ω term and demonstrate the units in terms of β. We find that the unit-less ratio r^{17}/v^8 maintains the numerical values of the dimensionful constants within a boundary, in SI units $r^{17}/v^8 = 0.813x10^{-59}$;

$$\beta = \frac{\Omega}{a^{1/3}} = \frac{\Omega v}{r^2} = \frac{\Omega}{t^{2/15}k^{1/5}} ...,\ unit = u \quad (85)$$

$$A = \beta^3(\frac{2^6\pi^3}{\alpha}) = \frac{2^6\pi^3\Omega^3}{\alpha}\frac{v^3}{r^6},\ u^3\ (a) \quad (86)$$

$$R = \beta^8(\frac{r^{17}}{v^8}) = \Omega^8 r,\ u^8 \quad (87)$$

$$L^{-1} = \beta^{13}\frac{1}{(2\pi^2\Omega^{15})}(\frac{r^{17}}{v^8}) = \frac{1}{2\pi^2\Omega^2}\frac{v^5}{r^9},\ u^{13}\ (1/m) \quad (88)$$

$$M = \beta^{15}(\frac{1}{\Omega^{15}})(\frac{r^{17}}{v^8})^2 = \frac{r^4}{v},\ u^{15}\ (kg) \quad (89)$$

$$P = \beta^{16}(\frac{1}{\Omega^{15}})(\frac{r^{17}}{v^8})^2 = \Omega r^2,\ u^{16}\ (q) \quad (90)$$

$$V = \beta^{17}(\frac{2\pi}{\Omega^{15}})(\frac{r^{17}}{v^8})^2 = 2\pi\Omega^2 v,\ u^{17}\ (m/s) \quad (91)$$

$$T^{-1} = \beta^{30}(\frac{1}{2\pi\Omega^{30}})(\frac{r^{17}}{v^8})^3 = \frac{1}{2\pi}\frac{v^6}{r^9},\ u^{30}\ (1/s) \quad (92)$$

$$\mu_0^* = \beta^{56}(\frac{\alpha}{2^{11}\pi^5\Omega^{60}})(\frac{r^{17}}{v^8})^7 = \frac{\alpha}{2^{11}\pi^5\Omega^4}r^7,\ u^{56} \quad (93)$$

$$\epsilon_0^{*-1} = \beta^{90}(\frac{\alpha}{2^9\pi^3\Omega^{90}})(\frac{r^{17}}{v^8})^{11} = \frac{\alpha}{2^9\pi^3}v^2 r^7,\ u^{90} \quad (94)$$

4.6. We can numerically solve the physical constants by replacing the mathematical (c^*, μ_0^*, R^*) with the CODATA mean values for (c, μ_0, R) as in section 3.8.

$$h^* = \beta^{19}(\frac{2^3\pi^4}{\Omega^{15}})(\frac{r^{17}}{v^8})^3,\ u^{19} \quad (95)$$

We then find there is a combination of (c^*, μ_0^*, R^*) which reduces to h^3.

$$(h^*)^3 = \frac{2\pi^{10}(\mu_0^*)^3}{3^6(c^*)^5\alpha^{13}(R^*)^2},\ unit = u^{57} \quad (96)$$

Likewise with the other dimensionful constants, we note that these equations are equivalent to section 3.8;

$$(e^*)^3 = \frac{4\pi^5}{3^3(c^*)^4\alpha^8(R^*)},\ unit = u^{-81} \quad (97)$$

$$(k_B^*)^3 = \frac{\pi^5(\mu_0^*)^3}{3^3 2(c^*)^4\alpha^5(R^*)},\ unit = u^{87} \quad (98)$$

$$(G^*)^5 = \frac{\pi^3(\mu_0^*)}{2^{20}3^6\alpha^{11}(R^*)^2},\ unit = u^{30} \quad (99)$$

$$(m_e^*)^3 = \frac{16\pi^{10}(R^*)(\mu_0^*)^3}{3^6(c^*)^8\alpha^7},\ unit = u^{45} \quad (100)$$

$$(r_d)^3 = \frac{3^3 4\pi^5(\mu_0^*)^3\alpha^{19}(R^*)^2}{5^3(c^*)^{10}},\ unit = u^{24} \quad (101)$$

5 Notes

In 1963, Dirac noted regarding the fundamental constants; ”The physics of the future, of course, cannot have the three quantities $\hbar, e, c$ all as fundamental quantities. Only two of them can be fundamental, and the third must be derived from those two.” [25]

In the article ”Surprises in numerical expressions of physical constants”, Amir et al write ... In science, as in life, ‘surprises’ can be adequately appreciated only in the presence of a null model, what we expect a priori. In physics, theories sometimes express the values of dimensionless physical constants as combinations of mathematical constants like pi or e. The inverse problem also arises, whereby the measured value of a physical constant admits a ‘surprisingly’ simple approximation in terms of well-known mathematical constants. Can we estimate the probability for this to be a mere coincidence? [24]

J. Barrow and J. Webb on the fundamental constants; ’Some things never change. Physicists call them the *constants of nature*. Such quantities as the velocity of light, c, Newton’s constant of gravitation, G, and the mass of the electron, m_e, are assumed to be the same at all places and times in the universe. They form the scaffolding around which theories of physics are erected, and they define the fabric of our universe. Physics has progressed by making ever more accurate measurements of their values. And yet, remarkably, no one has ever successfully predicted or explained any of the constants. Physicists have no idea why they take the special numerical values that they do. In SI units, c is 299,792,458; G is 6.673e-11; and m_e is 9.10938188e-31 -numbers that follow no discernible pattern. The only thread running through the values is that if many of them were even slightly different, complex atomic structures such as living beings would not be possible. The desire to explain the constants has been one of the driving forces behind efforts to develop a complete unified description of nature, or ”theory of everything”. Physicists have hoped that such a theory would show that each of the constants of nature could have only one logically possible value. It would reveal an underlying order to the seeming arbitrariness of nature.’ [6].

At present, there is no candidate theory of everything that is able to calculate the mass of the electron [23].

”There are two kinds of fundamental constants of Nature: dimensionless (alpha) and dimensionful (c, h, G). To clarify the discussion I suggest to refer to the former as fundamental parameters and the latter as fundamental (or basic) units. It is necessary and sufficient to have three basic units in order to reproduce in an experimentally meaningful way the dimensions of all physical quantities. Theoretical equations describing the physical world deal with dimensionless quantities and their solutions depend on dimensionless fundamental parameters. But experiments, from which these theories are extracted and by which they could be tested, involve measurements, i.e. comparisons with standard dimensionful scales. Without standard dimensionful units and hence without certain conventions physics is unthinkable” -*Trialogue* [5].

”The fundamental constants divide into two categories, units independent and units dependent, because only the constants in the former category have values that are not determined by the human convention of units and so are true fundamental constants in the sense that they are inherent properties of our universe. In comparison, constants in the latter category are not fundamental constants in the sense that their particular values are determined by the human convention of units” -*L. and J. Hsu* [4].

A charged rotating black hole is a black hole that possesses angular momentum and charge. In particular, it rotates about one of its axes of symmetry. In physics, there is a speculative notion that if there were a black hole with the same mass and charge as an electron, it would share many of the properties of the electron including the magnetic moment and Compton wavelength. This idea is substantiated within a series of papers published by Albert Einstein between 1927 and 1949. In them, he showed that if elementary particles were treated as singularities in spacetime, it was unnecessary to postulate geodesic motion as part of general relativity [14].

The Dirac Kerr–Newman black-hole electron was introduced by Burinskii using geometrical arguments. The Dirac wave function plays the role of an order parameter that signals a broken symmetry and the electron acquires an extended space-time structure. Although speculative, this idea was corroborated by a detailed analysis and calculation [8].

Max Tegmark’s Mathematical Universe Hypothesis: Our external physical reality is a mathematical structure. That is, the physical universe is mathematics in a well-defined sense, and ”in those [worlds] complex enough to contain self-aware substructures [they] will subjectively perceive themselves as existing in a physically ’real’ world” [10].

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