Programming Planck units from a virtual (black-hole) electron; a Simulation Hypothesis

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The simulation hypothesis proposes that all of reality is an artificial simulation. In this article I describe a programmable simulation method that constructs the Planck units as geometrical forms derived from a virtual electron f_e ($f_e = 4\pi^2 r^3; r = 2^6 3\pi^2 \alpha\Omega^5$, units = 1), itself a function of 2 unit-less mathematical constants; the fine structure constant α and Ω = 2.0071349496... The Planck units are embedded in f_e according to these ratios; M^9T^{11}/L^{15}, $(AL)^3/T$ ... units = 1; giving geometries mass M=1, time T=2π, velocity V = $2\pi\Omega^2$, length L=$2\pi^2\Omega^2$ ... We can thus for example create as much mass M as we wish but with the proviso that we create an equivalent space L and time T in accordance with these ratio. The 5 SI units kg, m, s, A, K are replaced by a single unit u that defines the relationships between the SI units; kg = u^{15}, m= u^{-13}, s = u^{-30}, A = u^3 ... The units for u are sqrt(velocity/mass). To convert from base (Planck) geometries to their respective SI numerical values requires 2 dimensioned scalars with which we can then solve the SI physical constants G, h, e, c, m_e, k_B. Results are consistent with CODATA 2014 (see table, numerical scalars k, v from m_P and c). The rationale for the virtual electron was derived via the sqrt of Planck momentum and a black-hole electron model as a function of magnetic-monopoles AL and time T. In summary we can reproduce both the physical constants G, h, e, c, m_e, k_B and the SI units kg, m, s, A, K via a this virtual electron using 2 mathematical constants (α, Ω), 2 dimensioned scalars (whose numerical values depend on the system of units used) and 1 dimensioned unit u.

Table 1	Calculated* (α, Ω, k, v)	CODATA 2014
Speed of light	V = 299792458 u^{17}	c = 299792458
Permeability	$\mu_0{}^* = 4\pi/10^7\ u^{56}$	$\mu_0 = 4\pi/10^7$
Rydberg constant	$R_\infty{}^*$ = 10973731.568 508 u^{13}	R_∞ = 10973731.568 508(65) [15]
Planck constant	h^* = 6.626 069 134 e-34 u^{19}	h = 6.626 070 040(81) e-34 [16]
Elementary charge	e^* = 1.602 176 511 30 e-19 u^{-27}	e = 1.602 176 6208(98) e-19 [19]
Electron mass	m_e^* = 9.109 382 312 56 e-31 u^{15}	m_e = 9.109 383 56(11) e-31 [17]
Boltzmann's constant	k_B^* = 1.379 510 147 52 e-23 u^{29}	k_B = 1.380 648 52(79) e-23 [22]
Gravitation constant	G^* = 6.672 497 192 29 e-11 u^6	G = 6.674 08(31) e-11 [21]

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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 [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 (defined here Planck mass m_P, Planck time t_p, Planck length l_p, Planck charge A_Q, Planck temperature T_P) 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.

2 The virtual universe

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

This article describes a mathematical universe model that is based on a virtual electron ($f_e = 4\pi^2 r^3; r = 2^6 3\pi^2 \alpha\Omega^5$) from which the Planck units can be derived as geometrical forms. The fine structure constant α, π and a recurring constant Ω are dimensionless mathematical constants, thus the electron formula f_e is also a mathematical constant, and as such has a numerical solution that is independent of the system of units used ($f_e = 0.2389545x10^{23}$).

From this electron formula we can derive the Planck units as geometrical forms; mass M=1, time T=2π, velocity V = $2\pi\Omega^2$, length L=$2\pi^2\Omega^2$ ... (4.1).

The 5 SI units kg, m, s, A, k are replaced by a single unit u (5.0) which defines the relationships between the SI units. The units for u are $\sqrt{velocity/mass}$. The functionality of each (Planck) unit is embedded into its α, Ω geometry.

To solve the physical constants in SI terms also requires 2 scalars to convert from these base geometries to their respective SI values (4.2), i.e.: using the following values for α, Ω, k, v gives the results in the table (p1) for G, h, c, e, m_e, k_B;

$k = m_P = .2176728175...x10^{-7}\ u^{15}$ (kg)

$v = (2\pi\Omega^2)/c = 11843707.9...\ u^{17}$ (m/s)

$\alpha = 137.035999139$ CODATA mean (4.4)

$\Omega = 2.0071349496...$; (4.5)

Thus we may construct our physical mass, space and time using 2 dimensionless constants (α, Ω), 2 dimensioned scalars and a single unit u using mathematical forms derived from a virtual electron.

3 Sqrt of Planck momentum

In this section I introduce the sqrt of momentum as a distinct Planck unit and use this to link the mass and the charge constants. From the formulas for the charge constants I derive a formula for a magnetic monopole (ampere-meter AL) and from this a formula for an electron f_e. I then argue that f_e is dimensionless as the monopole and time units are not independent but rather overlap, collapsing within the electron according to this ratio; $f_e = (AL)^3/T$, units = 1. Being dimensionless and so independent of any system of units, this electron formula is a mathematical constant.

Note: for convenience I use the commonly recognized value for alpha as $\alpha \sim 137.036$

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;

$$Q = 1.019\ 113\ 411...,\ unit = q \quad (1)$$

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;

$$m_P = \frac{2\pi Q^2}{c},\ unit = kg \quad (2)$$

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

$$t_p = \frac{2l_p}{c},\ unit = s \quad (4)$$

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

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

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

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

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

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

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.

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

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

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

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

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 ($\sigma_e = 0.13708563x10^{-6}$);

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

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

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

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);

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

This however now gives us 2 solutions for length m, see eq(1) and eq(15), 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 further reduce the number of units required, 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 Base units

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; $f_e = .23895453...x10^{23}$ units = 1. For example we can write the formula for f_e in terms of T= t_p, A = eT, V = $2l_p/T$;

$$f_e = (\frac{3\alpha^2 ATV}{2\pi^2})^3 \frac{1}{T} = 0.239x10^{23},\ unit = 1 \quad (41)$$

Because the numerical value is fixed and units = 1, we can look for other, non SI sets of ATV (AL) units which can also be used to solve f_e. In this section I describe the base units MLTA in terms of a geometrical component constructed from 2 fixed dimensionless mathematical constants; the fine structure constant alpha and a proposed Omega (4.5), from 2 variable unit-dependent scalars (from the list $ktlvpa$), and a relational unit u that replaces the SI units (kg, m, s, A, k).

$$M = (1)k,\ unit = u^{15}\ (mass) \quad (42)$$

$$T = (2\pi)t,\ unit = u^{-30}\ (time) \quad (43)$$

$$P = (\Omega)p,\ unit = u^{16}\ (sqrt\ of\ momentum) \quad (44)$$

$$V = (2\pi\Omega^2)v,\ unit = u^{17}\ (velocity) \quad (45)$$

$$L = (2\pi^2\Omega^2)l,\ unit = u^{-13}\ (length) \quad (46)$$

$$A = (\frac{2^6\pi^3\Omega^3}{\alpha})a,\ unit = u^3\ (ampere) \quad (47)$$

4.2 In the previous section I used 2 base units to define the others. In this example I use P, V (p units = u^{16}, v units = u^{17}) to 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

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

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

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

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

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

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

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

For convenience here 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), see table p1;

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

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

I suggested ratios where units = 1 (eq21). Setting SI Planck unit values whereby M = m_P, T = t_p, L = l_p, A = A_Q (4.1);

$$\frac{L^{15}}{M^9T^{11}} = \frac{l_p^{15}}{m_P^9 t_p^{11}} = \frac{(2\pi^2\Omega^2)^{15}}{(1)^9(2\pi)^{11}}.\frac{l^{15}}{k^9t^{11}} = 2^4\pi^{19}\Omega^{30} \quad (66)$$

$$\frac{l^{15}}{k^9t^{11}} = \frac{(.20322087^{-36})^{15}}{(.217672818^{-7})^9(.171585513^{-43})^{11}}\frac{u^{-13*15}}{u^{15*9}u^{-30*11}} = 1 \quad (67)$$

$$\frac{A^3L^3}{T} = \frac{A_Q^3 l_p^3}{t_p} = \frac{(2^6\pi^3\Omega^3)^3(2\pi^2\Omega^2)^3}{(\alpha)^3(2\pi)}.\frac{a^3l^3}{t} = \frac{2^{20}\pi^{14}\Omega^{15}}{\alpha^3} \quad (68)$$

$$\frac{a^3l^3}{t} = \frac{(.12691859^{23})^3(.20322087^{-36})^3}{(.171585513^{-43})}\frac{u^{3*3}u^{-13*3}}{u^{-30}} = 1 \quad (69)$$

If we then define MLTA in terms of PV in these ratios, we find that P and V themselves cancel leaving only the dimensionless components. Consequently these ratios are unit-less, it is via this Ω^{15} configuration that the Planck units may be constructed.

$$\frac{L^{30}}{M^{18}T^{22}} = \frac{2^{180}\pi^{210}\Omega^{225}P^{135}}{V^{150}} / \frac{2^{18}\pi^{18}P^{36}}{V^{18}} . \frac{2^{154}\pi^{154}\Omega^{165}P^{99}}{V^{132}} \tag{70}$$

$$\frac{L^{30}}{M^{18}T^{22}} = (2^4\pi^{19}\Omega^{15})^2 \tag{71}$$

$$\frac{A^6L^6}{T^2} = \frac{2^{18}V^{18}}{\alpha^6P^{18}} . \frac{2^{36}\pi^{42}\Omega^{45}P^{27}}{V^{30}} / \frac{2^{14}\pi^{14}\Omega^{15}P^9}{V^{12}} \tag{72}$$

$$\frac{A^6L^6}{T^2} = (\frac{2^{20}\pi^{14}\Omega^{15}}{\alpha^3})^2 \tag{73}$$

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

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

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

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

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

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

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

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

$$scalars = \frac{r^{13}}{v^5} . \frac{1}{r^7} . \frac{v^6}{r^6} . \frac{1}{v} = 1 \tag{80}$$

$$units = \frac{u^{19}}{u^{56}(u^{-27})^2 u^{17}} = 1 \tag{81}$$

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^*;

$\Omega = 2.0071349496...$;

$$\frac{(c^*)^{35}}{(\mu_0^*)^9(R^*)^7},\ units = \frac{(u^{17})^{35}}{(u^{56})^9(u^{13})^7} = 1 \tag{82}$$

$$\frac{(c^*)^{35}}{(\mu_0^*)^9(R^*)^7} = (2\pi\Omega^2)^{35}/(\frac{\alpha}{2^{11}\pi^5\Omega^4})^9 . (\frac{1}{2^{23}3^3\pi^{11}\alpha^5\Omega^{17}})^7 \tag{83}$$

$$\Omega^{225} = \frac{(c^*)^{35}}{2^{295}3^{21}\pi^{157}(\mu_0^*)^9(R^*)^7\alpha^{26}},\ units = 1 \tag{84}$$

There is a close sqrt natural number solution for Ω;

$$\Omega = \sqrt{\left(\frac{\pi^e}{e^{(e-1)}}\right)} = 2.0071\ 349\ 5432... \tag{85}$$

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. We then find there is a combination of (c^*, μ_0^*, R^*) which reduces to h^3 using the formulas in 4.2.

$$h^* = 2^3\pi^4\Omega^4 \frac{r^{13}}{v^5},\ u^{19} \tag{86}$$

$$(h^*)^3 = \frac{2\pi^{10}(\mu_0^*)^3}{3^6(c^*)^5\alpha^{13}(R^*)^2},\ unit = u^{57} \tag{87}$$

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

$$(e^*)^3 = \frac{4\pi^5}{3^3(c^*)^4\alpha^8(R^*)},\ unit = u^{-81} \tag{88}$$

$$(k_B^*)^3 = \frac{\pi^5(\mu_0^*)^3}{3^3 2(c^*)^4\alpha^5(R^*)},\ unit = u^{87} \tag{89}$$

$$(G^*)^5 = \frac{\pi^3(\mu_0^*)}{2^{20}3^6\alpha^{11}(R^*)^2},\ unit = u^{30} \tag{90}$$

$$(m_e^*)^3 = \frac{16\pi^{10}(R^*)(\mu_0^*)^3}{3^6(c^*)^8\alpha^7},\ unit = u^{45} \tag{91}$$

$$(r_d)^3 = \frac{3^3 4\pi^5(\mu_0^*)^3\alpha^{19}(R^*)^2}{5^3(c^*)^{10}},\ unit = u^{24} \tag{92}$$

5 Unit u

Here I assign a hypothetical β; unit = u and in this example use as scalars (r, v).

$$\beta = 2\pi\Omega a^{1/3} = \frac{2\pi\Omega v}{r^2} = \frac{2\pi\Omega}{t^{2/15}k^{1/5}} = \frac{2\pi\Omega\sqrt{v}}{\sqrt{k}} ...,\ unit = u \tag{93}$$

$$i = \frac{1}{2\pi(2\pi\Omega)^{15}},\ unit = 1$$

$$j = \frac{r^{17}}{v^8},\ unit = \frac{u^{8*17}}{u^{17*8}} = 1$$

$$A = \beta^3(\frac{2^3}{\alpha}) = \frac{2^6\pi^3\Omega^3}{\alpha}\frac{v^3}{r^6},\ u^3 \tag{94}$$

$$G = \frac{\beta^6}{2^3\pi^2}(j) = 2^3\pi^4\Omega^6\frac{r^5}{v^2},\ u^6 \tag{95}$$

$$R = \beta^8(\sqrt{i}j) = \Omega^8 r,\ u^8 \tag{96}$$

$$L^{-1} = 4\pi\beta^{13}(ij) = \frac{1}{2\pi^2\Omega^2}\frac{v^5}{r^9},\ u^{13} \tag{97}$$

$$M = 2\pi\beta^{15}(ij^2) = \frac{r^4}{v},\ u^{15} \tag{98}$$

$$P = \beta^{16}(ij^2) = \Omega r^2,\ u^{16} \tag{99}$$

$$V = \beta^{17}(ij^2) = 2\pi\Omega^2 v,\ u^{17} \tag{100}$$

$$T_P^* = \frac{2^3\beta^{20}}{\pi\alpha}(ij^2) = \frac{2^7\pi^3\Omega^5}{\alpha}\frac{v^4}{r^6},\ u^{20} \tag{101}$$

$$T^{-1} = 2\pi\beta^{30}(i^2j^3) = \frac{1}{2\pi}\frac{v^6}{r^9},\ u^{30} \tag{102}$$

$$\mu_0^* = \frac{\pi^3\alpha\beta^{56}}{2^3}(i^4j^7) = \frac{\alpha}{2^{11}\pi^5\Omega^4}r^7,\ u^{56} \tag{103}$$

$$\epsilon_0^{*-1} = \frac{\pi^3\alpha\beta^{90}}{2^3}(i^6j^{11}) = \frac{\alpha}{2^9\pi^3}v^2r^7,\ u^{90} \tag{104}$$

In SI units;

$$a^{1/3} = \frac{v}{r^2} = \frac{1}{t^{2/15}k^{1/5}} = \frac{\sqrt{v}}{\sqrt{k}}... = 23326079.1...; unit = u \tag{105}$$

$$\frac{r^{17}}{v^8} = k^2 t = \frac{k^{17/4}}{v^{15/4}}... = 0.813x10^{-59},\ units = \frac{u^{17*8}}{u^{8*17}}... = 1 \tag{106}$$

Combining these unit=1 x, y ratios with unit u, we can derive the SI unit equivalents;

$$x = \sqrt{\frac{M^9T^{11}}{L^{15}}},\ units = \sqrt{\frac{kg^9s^{11}}{m^{15}}} = 1 \tag{107}$$

$$y = M^2T,\ units = kg^2s = 1 \tag{108}$$

$$u,\ units = \sqrt{\frac{V}{M}} = \sqrt{\frac{m}{kg.s}} \tag{109}$$

$$u^3 = \frac{m^3}{q^3s^3} = A_Q\ (eq.6)$$

$$u^6 * y = m^3/s^2kg\ (G)$$

$$(u^8 * y)^2 * x = q$$

$$u^{13} * x * y = 1/m\ (l_p^{-1})$$

$$u^{15} * x * y^2 = kg\ (m_P)$$

$$u^{16} * x * y^2 = q\ (Q)$$

$$u^{17} * x * y^2 = m/s\ (c)$$

$$u^{20} * x * y^2 = q^5/kg^4\ (T_P,\ eq.8)$$

$$u^{30} * x^2 * y^3 = 1/s\ (t_p^{-1})$$

$$u^{56} * x^4 * y^7 = kg^6/q^4s\ (\mu_0,\ eq.11)$$

$$u^{90} * x^6 * y^{11} = u^{56} * u^{17} * u^{17}\ (\epsilon_0^{-1})$$

$$T/(AL)^3;\ units = \frac{(u^{13} * x * y)^3}{u^9 * (u^{30} * x^2 * y^3)} = x \tag{110}$$

$$T^2T_P^3;\ units = \frac{(u^{20} * x * y^2)^3}{(u^{30} * x^2 * y^3)^2} = 1/x \tag{111}$$

$$M^9T^{11}/L^{15};\ units = \frac{(u^{15} * x * y^2)^9 * (u^{13} * x * y)^{15}}{(u^{30} * x^2 * y^3)^{11}} = x^2 \tag{112}$$

6 Virtual universe

The electron formula f_e can be constructed from ampere-meters AL and time T and yet it is a dimensionless (mathematical) constant;

$f_e = (AL)^3/T = 0.239x10^{23}$, units = 1

This formula has 3 space dimensions L^3 and 1 time dimension T. We could then speculate that if the vacuum of our 3-D space is electro-magnetic in nature such that it is also a construct of an ampere-meters $(AL)^3$ 'ether' instead of an empty void measured in L^3 meters, then the sum universe may also be a dimensionless (mathematical) constant (aka a virtual universe) [27];

$f_{universe} = X(AL)^3/T$, units = 1

In the "Trialogue on the number of fundamental physical constants" was debated the number, from 0 to 3, of dimensionful units required [5]. Here the answer is both 0 and 1; 0 in that the electron, being a virtual particle, has no units, yet it can unfold into the Planck units and these can be deconstructed in terms of the unit u = sqrt(velocity/mass), and so in terms of the physical universe, being a dimensioned universe (a universe of measurable units) the answer is 1.

7 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 [26].

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].

Note: This article is an extension of an earlier article [26] which has been incorporated as section 3.

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