Planck units in a Mathematical Universe via sqrt Planck momentum and a black-hole electron model

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The fundamental physical constants are regarded as immutable and as non-derivable from more fundamental principles. They can be categorized between dimensionless and dimensionful constants, i.e.: those constants that describe a physical quantity but whose numerical value depends on the system of units used. In the "Trialogue on the number of fundamental physical constants" was debated the number, from 0 to 3, of dimensionful units required. Described here is a model based on a black-hole electron that uses 2 mathematical constants (the fine structure constant alpha and a proposed Omega) and 1 dimensionful unit u to define the SI units kg, m, s, A, K as interlocking geometrical forms. From these, the SI numerical value for the ampere can be used as a scalar to derive the SI values for the physical constants G, h, c, e, m_e, k_B. Units for MLTA (mass, length, time, ampere) are proposed as overlapping and canceling in these ratios; $(AL)^3/T = M^9T^{11}/L^{15}$, units = 1. These ratios are embedded in a dimensionless electron function f_e whereby the electron is seen as periodically oscillating between 2 states; a magnetic-monopole $(AL)^3$ and time T 'electric-state' and a 'mass-state'. The geometries of mass M=1, time T=2π, velocity V=$2\pi\Omega^2$, length L=$2\pi^2\Omega^2$ suggest angular motion may be the means by which dimensionality is conferred to mathematical forms. The u^n relationships suggest that dimensionful units are mathematical rather than physical constructs, if so then 0 dimensionful units are required, a key condition for a virtual or a mathematical universe hypothesis. The sqrt of Planck momentum is used to link charge constants with mass constants, this permits us to define and solve the least accurate dimensionful constants G, h, e, m_e, k_B... using the fine structure constant and the 3 most accurate dimensionful constants; c, μ_0 (exact values), and the Rydberg constant (12-13 digits precision).

Table 1	Calculated using R, c, μ_0, α	CODATA 2014
Fine structure constant alpha	(137.035999 139)	α = 137.035 999 139(31) [15]
Rydberg constant	(10973731.568 508)	R_∞ = 10 973 731.568 508(65) [12]
Planck constant	h^* = 6.626 069 134 e-34	h = 6.626 070 040(81) e-34 [13]
Elementary charge	e^* = 1.602 176 511 30 e-19	e = 1.602 176 6208(98) e-19 [16]
Electron mass	m_e^* = 9.109 382 312 56 e-31	m_e = 9.109 383 56(11) e-31 [14]
Boltzmann's constant	k_B^* = 1.379 510 147 52 e-23	k_B = 1.380 648 52(79) e-23 [19]
Gravitation constant	G^* = 6.672 497 192 29 e-11	G = 6.674 08(31) e-11 [18]

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1 Background

Planck units are a set of natural units of measurement defined exclusively in terms of five universal physical constants, in such a manner that these five physical constants take on the numerical value of $G = \hbar = c = 1/4\pi\epsilon_0 = k_B = 1$ when expressed in terms of these units. These units are also known as natural units because the origin of their definition comes only from properties of nature and not from any human construct.

"we get the possibility to establish units for length, mass, time and temperature which, being independent of specific bodies or substances, retain their meaning for all times and all cultures, even non-terrestrial and non-human ones and could therefore serve as natural units of measurements..."
-M Planck [7].

"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* [2].

"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* [1].

1.1. *Outline:*

It is proposed here that MLT (mass, length, time) are not independent but rather overlap and cancel according to the ratio M^9T^{11}/L^{15}; units = 1. An equivalent ratio for charge $(AL)^3/T$; units = 1 where AL (ampere-length) is a magnetic monopole. These ratio occur in a dimensionless electron formula f_e that dictates the periodicity of the electron. This electron formula is a natural mathematical constant.

Via f_e, the physical constants (G, h, e, c, m_e, k_B) are defined as geometrical forms according to 2 dimensionless numbers; the fine structure constant α and a proposed Ω and a dimensionful unit u. To solve in SI terms, I split an ampere unit = a into 2 scalable sub-units. In the example below I use as sub-units (k, t) where $k = 1$ unit of Planck mass m_P and $2\pi t = 1$ unit of Planck time t_p. In section 3 I also define the dimensionful units for MLT in terms of u^n.

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

$$M = m_P = (1)k,\ unit = kg \quad (2)$$

$$T = t_p = (2\pi)t,\ unit = s \quad (3)$$

Constants and their SI equivalents:

$$V = c = 2\pi M\beta^2 = (2\pi\Omega^2)\frac{k^{3/5}}{t^{4/15}},\ unit = \frac{kg}{u^2} = \frac{m}{s} \quad (4)$$

$$L = l_p = \frac{TV}{2} = (2\pi^2\Omega^2)t^{11/15}k^{3/5},\ unit = \frac{kgs}{u^2} = m \quad (5)$$

$$A = \frac{(4\pi\beta)^3}{\alpha} = (\frac{64\pi^3\Omega^3}{\alpha})\frac{1}{t^{2/5}k^{3/5}},\ unit = u^3 = a\ (ampere) \quad (6)$$

$$G = \frac{V^2L}{M} \quad (7)$$

$$e = AT,\ unit = u^3s \quad (8)$$

$$h = 4\pi^2LMV \quad (9)$$

$$k_B = \frac{\pi VM}{A},\ unit = \frac{kg^2}{u^5} \quad (10)$$

$$f_e = \frac{1}{T}(\frac{\pi^2}{3\alpha^2AL})^3,\ (t^0k^0u^0) \quad (11)$$

$$m_e = \frac{M}{f_e},\ unit = kg \quad (12)$$

2 Sqrt of Planck momentum Q

Here I introduce the sqrt of momentum as a link between mass and charge and using SI constants demonstrate how this may be used to reduce the number of required dimensionful units. Defining Q as the sqrt of Planck momentum where Planck momentum = $m_Pc = 2\pi Q^2 = 6.52485...\ kg.m/s$, and a unit q whereby $q^2 = kg.m/s$ giving;

$$Q = 1.019\ 113\ 411...,\ unit = q \quad (13)$$

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

2.1. The mass constants in terms of Q^2, c, l_p;

$$m_P = \frac{2\pi Q^2}{c},\ unit = kg \quad (14)$$

$$E_p = m_Pc^2 = 2\pi Q^2c,\ units = \frac{kg.m^2}{s^2} = \frac{q^4}{kg} \quad (15)$$

$$t_p = \frac{2l_p}{c},\ unit = s \quad (16)$$

$$F_p = \frac{2\pi Q^2}{t_p},\ units = \frac{q^2}{s} \quad (17)$$

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

$$A_Q = \frac{8c^3}{\alpha Q^3},\ unit\ A = \frac{m^3}{q^3s^3} = \frac{q^3}{kg^3} \quad (18)$$

$$e = A_Qt_p = \frac{8c^3}{\alpha Q^3}.\frac{2l_p}{c} = \frac{16l_pc^2}{\alpha Q^3},\ units = A.s = \frac{q^3s}{kg^3} \quad (19)$$

$$T_p = \frac{A_Qc}{\pi} = \frac{8c^3}{\alpha Q^3}.\frac{c}{\pi} = \frac{8c^4}{\pi\alpha Q^3},\ units = \frac{q^5}{kg^4} \quad (20)$$

$$k_B = \frac{E_p}{T_p} = \frac{\pi^2\alpha Q^5}{4c^3},\ units = \frac{kg^3}{q} \quad (21)$$

2.3. 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.

$$\frac{F_{electric}}{A_Q^2} = \frac{2\pi Q^2}{\alpha t_p}.(\frac{\alpha Q^3}{8c^3})^2 = \frac{\pi\alpha Q^8}{64l_pc^5} = \frac{2}{10^7} \quad (22)$$

$$\mu_0 = \frac{\pi^2\alpha Q^8}{32l_pc^5} = \frac{4\pi}{10^7},\ units = \frac{kg.m}{s^2A^2} = \frac{kg^6}{q^4s} \quad (23)$$

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

$$l_p = \frac{\pi^2\alpha Q^8}{32\mu_0c^5},\ unit = \frac{q^2s}{kg} = m \quad (24)$$

2.5. 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 [9].
A proposed magnetic monopole $\sigma_e = 0.13708563x10^{-6}$;

$$\sigma_e = \frac{3\alpha^2 ec}{2\pi^2},\ units = \frac{q^5 s}{kg^4} \tag{25}$$

An electron frequency function $f_e = 0.2389545x10^{23}$;

$$f_e = \frac{\sigma_e^3}{t_p} = \frac{2^8 3^3 \alpha^3 l_p^2 c^{10}}{\pi^6 Q^9} = \frac{3^3 \alpha^5 Q^7}{4\pi^2 \mu_0^2},\ units = \frac{q^{15} s^2}{kg^{12}} \tag{26}$$

2.6. Rydberg constant R_∞, note for m_e see eq(35);

$$R_\infty = \frac{m_e e^4 \mu_0^2 c^3}{8h^3} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi \alpha^8 Q^{15}},\ units = \frac{1}{m} = \frac{kg^{13}}{q^{17} s^3} \tag{27}$$

We now have 2 solutions for m, if they are both valid then we find a ratio whereby our units overlap and cancel;

$$m = \frac{q^2 s}{kg}.\frac{q^{15} s^2}{kg^{12}} = \frac{q^{17} s^3}{kg^{13}};\ \frac{q^{15} s^2}{kg^{12}} = 1 \tag{28}$$

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;

$$s = \frac{kg^6}{q^{15/2}} \tag{29}$$

$$R = \frac{q^{11/2}}{kg^5} \tag{30}$$

$$\mu_0 = q^{7/2} \tag{31}$$

We find this ratio is defined in the electron function f_e;

$$f_e = \frac{\sigma_e^3}{t_p};\ units = \frac{q^{15} s^2}{kg^{12}} = 1 \tag{32}$$

Replacing q with the more familiar m gives this ratio;

$$q^2 = \frac{kg.m}{s};\ q^{30} = (\frac{kg.m}{s})^{15} = \frac{kg^{24}}{s^4} \tag{33}$$

$$\frac{kg^9 s^{11}}{m^{15}} = 1 \tag{34}$$

Electron mass:

$$m_e = \frac{m_P}{f_e},\ unit = kg \tag{35}$$

Electron wavelength:

$$\lambda_e = 2\pi l_p f_e,\ units = m = \frac{q^2 s}{kg} \tag{36}$$

Gravitation coupling constant:

$$\alpha_G = (\frac{m_e}{m_P})^2 = \frac{1}{f_e^2},\ units = 1 \tag{37}$$

2.7. MLTVPA relationships in terms in T (P = sqrt of momentum, as an SI unit P = Q = sqrt Planck momentum);

$$T = \frac{L^{15/11}}{M^{9/11}} = \frac{M^6}{P^{15/2}} = \frac{P^{9/2}}{V^6} = A^3 L^3 = \frac{L^{6/5}}{P^{9/10}} = \frac{1}{A^2 P^{3/2}} ... \tag{38}$$

2.8. The Rydberg constant R_∞ = 10973731.568508(65) [12] with a 12-13 digit precision is the most accurate of the natural constants. The known precision of Planck momentum and so Q is low, however with the solution for the Rydberg constant eq(27) we may re-write Q in terms of; c, μ_0, R and α;

$$Q^{15} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi \alpha^8 R},\ units = \frac{kg^{12}}{s^2} = q^{15} \tag{39}$$

Using the formulas for Q^{15} eq(39) and l_p eq(24) we can re-write the least accurate constants in terms of the most accurate. We convert the constants until they include a Q^{15} term which can then be replaced by eq(39). Setting unit x as;

$$unit\ x = \frac{kg^{12}}{q^{15} s^2} = 1 \tag{40}$$

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

$$e = \frac{16 l_p c^2}{\alpha Q^3} = \frac{\pi^2 Q^5}{2\mu_0 c^3},\ units = \frac{q^3 s}{kg^3} \tag{41}$$

$$e^3 = \frac{\pi^6 Q^{15}}{8\mu_0^3 c^9} = \frac{4\pi^5}{3^3 c^4 \alpha^8 R},\ units = \frac{kg^3 s}{q^6} = (\frac{q^3 s}{kg^3})^3.x \tag{42}$$

Planck constant h = 6.626 069 134 e-34

$$h = 2\pi Q^2 2\pi l_p = \frac{4\pi^4 \alpha Q^{10}}{8\mu_0 c^5},\ units = \frac{q^4 s}{kg} \tag{43}$$

$$h^3 = (\frac{4\pi^4 \alpha Q^{10}}{8\mu_0 c^5})^3 = \frac{2\pi^{10} \mu_0^3}{3^6 c^5 \alpha^{13} R^2},\ units = \frac{kg^{21}}{q^{18} s} = (\frac{q^4 s}{kg})^3.x^2 \tag{44}$$

Boltzmann constant k_B = 1.379 510 14752 e-23

$$k_B = \frac{\pi^2 \alpha Q^5}{4c^3},\ units = \frac{kg^3}{q} \tag{45}$$

$$k_B^3 = \frac{\pi^5 \mu_0^3}{3^3 2 c^4 \alpha^5 R},\ units = \frac{kg^{21}}{q^{18} s^2} = (\frac{kg^3}{q})^3.x \tag{46}$$

Gravitation constant G = 6.672 497 19229 e-11

$$G = \frac{c^2 l_p}{m_P} = \frac{\pi \alpha Q^6}{64 \mu_0 c^2},\ units = \frac{q^6 s}{kg^4} \tag{47}$$

$$G^5 = \frac{\pi^3 \mu_0}{2^{20} 3^6 \alpha^{11} R^2},\ units = kg^4 s = (\frac{q^6 s}{kg^4})^5.x^2 \tag{48}$$

Planck length

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

Planck mass

$$m_P^{15} = \frac{2^{25}\pi^{13}\mu_0^6}{3^6 c^5 \alpha^{16} R^2},\ units = kg^{15} = \frac{kg^{39}}{q^{30}s^4}.\frac{1}{x^2} \tag{50}$$

Electron mass m_e = 9.109 382 31256 e-31

$$m_e^3 = \frac{16\pi^{10} R \mu_0^3}{3^6 c^8 \alpha^7},\ units = kg^3 = \frac{kg^{27}}{q^{30}s^4}.\frac{1}{x^2} \tag{51}$$

Ampere

$$A_Q^5 = \frac{2^{10}\pi 3^3 c^{10}\alpha^3 R}{\mu_0^3},\ units = \frac{q^{30}s^2}{kg^{27}} = (\frac{q^3}{kg^3})^5.\frac{1}{x} \tag{52}$$

2.9. ($\sqrt{q}$)

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

$$\sigma = \frac{2\pi^5 k_B^4}{15h^3c^2},\ r_d = \frac{4\sigma}{c},\ units = r \tag{53}$$

$$r_d^3 = \frac{3^3 4\pi^5 \mu_0^3 \alpha^{19} R^2}{5^3 c^{10}},\ units = \frac{kg^{30}}{q^{36}s^5}.\frac{1}{x^2} = \frac{kg^6}{q^6 s} = r^3 \tag{54}$$

3 Geometrical constants

3.1. The base Planck units are Planck mass m_P, Planck length l_p, Planck time t_p, Planck charge, Planck temperature. In this section I construct geometrical forms for the constants in terms of 2 dimensionless mathematical constants; the fine structure constant alpha and a proposed Omega and 2 scalable dimensionful units from $a^{1/3}$ (a being the unit for the ampere). In 1.1., as scalars I used (k, t), in this example I use r (r^4 = unit of momentum) and v (velocity).

$$\beta = \frac{\Omega}{a^{1/3}} = \frac{\Omega v}{r^2},\ unit = u \tag{55}$$

Expanded, our formulas eq(2-12) become;

$$A = \beta^3(\frac{2^6\pi^3}{\alpha}) = \frac{2^6\pi^3\Omega^3}{\alpha}\frac{v^3}{r^6},\ u^3\ (a) \tag{56}$$

$$G^* = \beta^6(2^3\pi^4)(\frac{r^{17}}{v^8}) = 2^3\pi^4\Omega^6\frac{r^5}{v^2},\ u^{-39-15+60=6} \tag{57}$$

$$R = \beta^8(\frac{r^{17}}{v^8}) = \Omega^8 r,\ u^8 \tag{58}$$

$$L^{-1} = \beta^{13}\frac{1}{(2\pi^2\Omega^{15})}(\frac{r^{17}}{v^8}) = \frac{1}{2\pi^2\Omega^2}\frac{v^5}{r^9},\ u^{13}\ (1/m) \tag{59}$$

$$M = \beta^{15}(\frac{1}{\Omega^{15}})(\frac{r^{17}}{v^8})^2 = \frac{r^4}{v},\ u^{15}\ (kg) \tag{60}$$

$$P = \beta^{16}(\frac{1}{\Omega^{15}})(\frac{r^{17}}{v^8})^2 = \Omega r^2,\ u^{16}\ (q) \tag{61}$$

$$V = \beta^{17}(\frac{2\pi}{\Omega^{15}})(\frac{r^{17}}{v^8})^2 = 2\pi\Omega^2 v,\ u^{17}\ (m/s) \tag{62}$$

$$h^* = \beta^{19}(\frac{2^3\pi^4}{\Omega^{15}})(\frac{r^{17}}{v^8})^3 = 2^3\pi^4\Omega^4\frac{r^{13}}{v^5},\ u^{15-26+30=19} \tag{63}$$

$$T_P^* = \beta^{20}(\frac{2^7\pi^3}{\alpha\Omega^{15}})(\frac{r^{17}}{v^8})^2 = \frac{2^7\pi^3\Omega^5}{\alpha}\frac{v^4}{r^6},\ u^{3+17=20} \tag{64}$$

$$e^{*-1} = \beta^{27}(\frac{\alpha}{2^7\pi^4\Omega^{30}})(\frac{r^{17}}{v^8})^3 = \frac{\alpha}{2^7\pi^4\Omega^3}\frac{v^3}{r^3},\ u^{30-3=27} \tag{65}$$

$$k_B^* = \beta^{29}(\frac{\alpha}{2^5\pi\Omega^{30}})(\frac{r^{17}}{v^8})^4 = \frac{\alpha}{2^5\pi\Omega}\frac{r^{10}}{v^3},\ u^{15+17-3=29} \tag{66}$$

$$T^{-1} = \beta^{30}(\frac{1}{2\pi\Omega^{30}})(\frac{r^{17}}{v^8})^3 = \frac{1}{2\pi}\frac{v^6}{r^9},\ u^{30}\ (1/s) \tag{67}$$

$$\mu_0^* = \beta^{56}(\frac{\alpha}{2^{11}\pi^5\Omega^{60}})(\frac{r^{17}}{v^8})^7 = \frac{\alpha}{2^{11}\pi^5\Omega^4}r^7,\ u^{56} \tag{68}$$

$$\epsilon_0^{*-1} = \beta^{90}(\frac{\alpha}{2^9\pi^3\Omega^{90}})(\frac{r^{17}}{v^8})^{11} = \frac{\alpha}{2^9\pi^3}v^2 r^7,\ u^{90} \tag{69}$$

$$r_\sigma = (\frac{8\pi^5 k_B^4}{15h^3c^3}) = \beta^8(\frac{\alpha^4}{2^{29}15\pi^{14}\Omega^{30}}).(\frac{r^{17}}{v^8}),\ u^8 \tag{70}$$

$$R^* = (\frac{m_e}{4\pi l_p \alpha^2 m_P}) = \beta^{13}(\frac{1}{2^{23}3^3\pi^{11}\alpha^5\Omega^{30}}).(\frac{r^{17}}{v^8}),\ u^{13} \tag{71}$$

As SI scalar values for β I used;

$t = (\frac{t_p}{2\pi})$

$k = m_p$

$a = (\frac{64\pi^3\Omega^3}{A_Q\alpha})$

$v = \frac{c}{2\pi\Omega^2} = 11843707.9$

$r = \sqrt{\frac{Q}{\Omega}} = .712562514$

$$a^{1/3} = \frac{r^2}{v} = t^{2/15}k^{1/5} = t^{1/6}\sqrt{r} \ldots = .4287047x10^{-7}$$

3.2. We can use the above table to derive the units for the constants. For example;

$e = t_p A, u^{-30+3=-27}$ and $r^{3*8}/v^{3*17} = u^{24-51=-27}$

$h = kg.m^2/s = u^{15-26+30=19}$ and $r^{13*8}/v^{5*17} = u^{104-85=19}$

3.3. Unit = 1 combinations (units $k = u^{15};\ t = u^{-30}$)

$$(\frac{r^{17}}{v^8} = \frac{(u^8)^{17}}{(u^{17})^8}) = (k^2 t = \frac{(u^{15})^2}{u^{30}}) = 0.813x10^{-59},\ units = 1 \tag{72}$$

$$M^2 = \frac{r^8}{v^2},\ unit = u^{8*8-17*2=30}\ (kg^2) \tag{73}$$

$$T^{-1} = \frac{v^6}{2\pi r^9},\ unit = u^{17*6-8*9=30}\ (1/s) \tag{74}$$

$$M^2 T = \frac{r^8}{v^2}\frac{2\pi r^9}{v^6} = 2\pi(\frac{r^{17}}{v^8}),\ unit = 1 \tag{75}$$

By using unitless combinations; Ω^{15}/Ω^{15} (for any mulitple of u^{15} there is no Ω) and r^{17}/v^8, we can maintain our numerical solutions to within limits (a boundary). We can also speculate on hypothetical constants, for example a $(u^{15})^n$ series;

$$u^{15};\ (\frac{v}{r^2})^{15}(\frac{r^{17}}{v^8})^2 = \frac{r^4}{v} \tag{76}$$

$$u^{30};\ (\frac{v}{r^2})^{30}(\frac{r^{17}}{v^8})^3 = \frac{v^6}{r^9} \tag{77}$$

$$u^{45};\ (\frac{v}{r^2})^{45}(\frac{r^{17}}{v^8})^5 = \frac{v^5}{r^5},\ (u^{5*17-5*8=45}) \tag{78}$$

$$u^{60};\ (\frac{v}{r^2})^{60}(\frac{r^{17}}{v^8})^7 = \frac{v^4}{r},\ (u^{4*17-1*8=60}) \tag{79}$$

$$u^{75};\ (\frac{v}{r^2})^{75}(\frac{r^{17}}{v^8})^9 = v^3 r^3,\ (u^{3*17+3*8=75}) \tag{80}$$

$$u^{90};\ (\frac{v}{r^2})^{90}(\frac{r^{17}}{v^8})^{11} = v^2 r^7,\ (u^{2*17+7*8=90}) \tag{81}$$

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

$$\sigma_e = \frac{3\alpha^2 AL}{\pi^2} = \beta^{10}\frac{1}{384\pi^3\alpha\Omega^{15}}(\frac{r^{17}}{v^8}) = 2^7\pi^3 3\alpha\Omega^5\frac{r^3}{v^2},\ u^{-10} \tag{82}$$

$$f_e = \frac{\sigma_e^3}{T} = 2^{20}3^3\pi^8\alpha^3\Omega^{15},\ units = \frac{u^{30}}{(u^{10})^3} = 1 \tag{83}$$

$$\sigma_{tp} = \frac{3\alpha^2 T_P}{2\pi} = 2^6\pi^2 3\alpha\Omega^5\frac{v^4}{r^6},\ units = u^{20} \tag{84}$$

$$f_e = t_p^2\sigma_{tp}^3 = \frac{(u^{20})^3}{(u^{30})^2} = 2^{20}3^3\pi^8\alpha^3\Omega^{15},\ units = 1 \tag{85}$$

3.4. Along with alpha I have premised a second mathematical constant which I have denoted Omega. Alpha appears in addition to the physical constants and so its value can be determined independently. Omega was derived from the formula for the electron f_e. We can use the precise c^*, μ_0^*, R^* to find a numerical solution for Omega;

$\Omega = 2.0071349496...$;

$$\frac{(c^*)^{35}}{(\mu_0^*)^9(R^*)^7},\ units = \frac{(u^{17})^{35}}{(u^{56})^9(u^{13})^7} = 1 \tag{86}$$

$$\frac{(c^*)^{35}}{(\mu_0^*)^9(R^*)^7} = (2\pi\Omega^2)^{35}/(\frac{\alpha}{2^{11}\pi^5\Omega^4})^9.(\frac{1}{2^{23}3^3\pi^{11}\alpha^5\Omega^{17}})^7 \tag{87}$$

$$\Omega^{225} = \frac{(c^*)^{35}}{2^{295}3^{21}\pi^{157}(\mu_0^*)^9(R^*)^7\alpha^{26}},\ units = 1 \tag{88}$$

There is a close sqrt natural number solution for Ω;

$$\Omega = \sqrt{\left(\frac{\pi^e}{e^{(e-1)}}\right)} = 2.0071\ 349\ 5432... \tag{89}$$

3.5. Fine structure constant alpha

$$\alpha = \frac{2h}{\mu_0 e^2 c} = 2.2\pi Q^2 2\pi l_p.\frac{32 l_p c^5}{\pi^2\alpha Q^8}.\frac{\alpha^2 Q^6}{256 l_p^2 c^4}.\frac{1}{c} = \alpha \tag{90}$$

$$\alpha = 2(8\pi^4\Omega^4)/(\frac{\alpha}{2^{11}\pi^5\Omega^4})(\frac{128\pi^4\Omega^3}{\alpha})^2(2\pi\Omega^2) = \alpha \tag{91}$$

$$units = \frac{u^{19}}{u^{56}(u^{-27})^2 u^{17}} = 1 \tag{92}$$

3.6. 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 2.8.

$$h^* = \beta^{19}(\frac{2^3\pi^4}{\Omega^{15}})(\frac{r^{17}}{v^8})^3,\ u^{19} \tag{93}$$

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

$$(h^*)^3 = \frac{2\pi^{10}(\mu_0^*)^3}{3^6(c^*)^5\alpha^{13}(R^*)^2},\ unit = u^{57} \tag{94}$$

Likewise with the other dimensionful constants, we note that these equations are equivalent to eq(41-48);

$$(e^*)^3 = \frac{4\pi^5}{3^3(c^*)^4\alpha^8(R^*)},\ unit = u^{-81} \tag{95}$$

$$(k_B^*)^3 = \frac{\pi^5(\mu_0^*)^3}{3^3 2(c^*)^4\alpha^5(R^*)},\ unit = u^{87} \tag{96}$$

$$(G^*)^5 = \frac{\pi^3(\mu_0^*)}{2^{20}3^6\alpha^{11}(R^*)^2},\ unit = u^{30} \tag{97}$$

$$(m_e^*)^3 = \frac{16\pi^{10}(R^*)(\mu_0^*)^3}{3^6(c^*)^8\alpha^7},\ unit = u^{45} \tag{98}$$

$$(r_d)^3 = \frac{3^3 4\pi^5(\mu_0^*)^3\alpha^{19}(R^*)^2}{5^3(c^*)^{10}},\ unit = u^{24} \tag{99}$$

3.7. Formulas in terms of k, t (from 1.1.)

$$\beta = \frac{\Omega}{a^{1/3}} = \frac{\Omega}{t^{2/15}k^{1/5}},\ unit = u \tag{100}$$

$$M = (1)k,\ unit = u^{15} \tag{101}$$

$$T = t_p = (2\pi)t,\ unit = u^{-30} \tag{102}$$

$$P = (\Omega)\frac{k^{4/5}}{t^{2/15}},\ u^{16} \tag{103}$$

$$V = \frac{2\pi P^2}{M} = (2\pi\Omega^2)\frac{k^{3/5}}{t^{4/15}},\ unit = u^{17} \tag{104}$$

$$L = \frac{TV}{2} = (2\pi^2\Omega^2)t^{11/15}k^{3/5},\ unit = u^{-13} \tag{105}$$

$$A = \frac{8V^3}{\alpha P^3} = (\frac{64\pi^3\Omega^3}{\alpha})\frac{1}{t^{2/5}k^{3/5}},\ unit = u^3 \tag{106}$$

$$G^* = \frac{V^2 L}{M} = (8\pi^4\Omega^6)t^{1/5}k^{4/5},\ unit = u^6 \tag{107}$$

$$h^* = 4\pi^2 LMV = (8\pi^4\Omega^4)t^{7/15}k^{11/5},\ unit = u^{19} \tag{108}$$

$$T_P^* = \frac{AV}{\pi} = (\frac{128\pi^3\Omega^5}{\alpha})\frac{1}{t^{2/3}},\ unit = u^{20} \quad (109)$$

$$e^* = AT = (\frac{128\pi^4\Omega^3}{\alpha})\frac{t^{3/5}}{k^{3/5}},\ unit = u^{-27} \quad (110)$$

$$k_B^* = \frac{\pi VM}{A} = (\frac{\alpha}{32\pi\Omega})t^{2/15}k^{11/5},\ unit = u^{29} \quad (111)$$

$$\mu_0^* = \frac{\pi V^2 M}{\alpha LA^2} = (\frac{\alpha}{2048\pi^5\Omega^4})\frac{k^{14/5}}{t^{7/15}},\ unit = u^{56} \quad (112)$$

$$\epsilon_0^* = (\frac{512\pi^3}{\alpha})\frac{t}{k^4},\ unit = u^{-90} \quad (113)$$

4 Comments

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." [22]

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? [21]

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.' [3]. At present, there is no candidate theory of everything that is able to calculate the mass of the electron [20].

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 [11].

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 [5].

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" [7].

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