Planck unit theory: Fine structure constant alpha and sqrt of Planck momentum

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The primary constants; G, c, h, e, α, k_B, m_e... range in precision from low G (4-digits) to exact values (c, μ_0). A major problem in constructing a Planck unit theory is that the Planck units are limited to the precision of G and so to 4-digits. By postulating the sqrt of Planck momentum Q as the link between mass and charge, a 'Planck' ampere A_Q is constructed as a geometrical shape; the volume of velocity/mass. From this Planck Ampere can then be derived μ_0 (permeability of vacuum) which in turn gives a formula for Planck length l_p and for a magnetic monopole ($A.l_p$). From the monopole can be formed an electron which is then used to solve the Rydberg constant R. Consequently G, h, e, m_e... can then be solved in terms of the 4 most accurate constants c, μ_0, Rydberg constant (12 digit precision) and the fine structure constant alpha α (10 digit precision). Planck temperature T_P and so Boltzmanns constant k_B are functions of the ampere and velocity $A.c$. The electron formula suggests a Planck unit theory whereby particles are dimensionless formulas dictating the frequency of Planck events via a periodic (analog) electric wave-state to digital (integer) Planck-time-mass point-state oscillation. This wave-particle duality (oscillation) suggests a MUH Mathematical Universe Hypothesis where particles and photons modulate magnetic monopoles. The dimensions of our universe then reduce to the 3 dimensions of motion; sqrt of Planck momentum, Planck time and c.

1 Introduction

J. Barrow et al noted in a Scientific American article... '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 the 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.' [1]

2 Quintessence momentum

Planck momentum (velocity*mass) = $2.\pi.Q^2$ [19]

$$Q = 1.019\ 113\ 4112...\ units = \sqrt{\frac{kg.m}{s}} \tag{1}$$

3 Mass constants

Defining in terms of Planck momentum (instead of Planck mass), the mass constants as Planck units become;

$$m_P = \frac{2.\pi.Q^2}{c} \tag{2}$$

$$G = \frac{l_p.c^3}{2.\pi.Q^2} \tag{3}$$

$$h = 2.\pi.Q^2.2.\pi.l_p \tag{4}$$

$$t_p = \frac{2.l_p}{c} \tag{5}$$

$$F_p = \frac{E_p}{l_p} = \frac{2.\pi.Q^2}{t_p} \tag{6}$$

4 Ampere A_Q

(Proposed) Ampere A_Q = velocity/mass [19]

$$A_Q = \frac{8.c^3}{\alpha.Q^3},\ units = \frac{m^2}{kg.s^2.\sqrt{(kg.m/s)}} = \left(\sqrt{\frac{m}{kg.s}}\right)^3 \tag{7}$$

Where:

Planck Temperature = $A_Q\ .\ c$
Elementary charge = $A_Q\ .\ t_p$
Magnetic monopole = $A_Q\ .\ l_p$
Electron = $t_p\ .\ (A_Q\ .\ l_p)^3$
Magneton = $A_Q\ .\ l_p^2$

5 Elementary charge

$$e = A.s = A_Q.t_p$$

$$e = \frac{8.c^3}{\alpha.Q^3}.\frac{2.l_p}{c} = \frac{16.l_p.c^2}{\alpha.Q^3},\ units = \frac{m^2}{kg.s.\sqrt{(kg.m/s)}} \quad (8)$$

6 Vacuum permeability

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.

$$\frac{F_{electric}}{A_Q^2} = \frac{2.\pi.Q^2}{\alpha.t_p}.(\frac{\alpha.Q^3}{8.c^3})^2 = \frac{\pi.\alpha.Q^8}{64.l_p.c^5} = \frac{2}{10^7} \quad (9)$$

gives:

$$\mu_0 = \frac{\pi^2.\alpha.Q^8}{32.l_p.c^5} = \frac{4.\pi}{10^7} \quad (10)$$

$$\epsilon_0 = \frac{32.l_p.c^3}{\pi^2.\alpha.Q^8} \quad (11)$$

$$k_e = \frac{\pi.\alpha.Q^8}{128.l_p.c^3} \quad (12)$$

7 Planck length l_p

l_p in terms of $Q,\ \alpha,\ c$.
The magnetic constant μ_0 has a fixed value. From eqn.10

$$l_p = \frac{\pi^2.\alpha.Q^8}{2^7.\mu_0.c^5} \quad (13)$$

$$\mu_0 = 4.\pi.10^{-7}\ N/A^2$$

$$l_p = \frac{5^7.\pi.\alpha.Q^8}{c^5} \quad (14)$$

8 Electron as magnetic monopole

m_e in terms of $m_P,\ t_p,\ \alpha,\ e,\ c$. [19]

The ampere-meter is the SI unit for pole strength (the product of charge and velocity) in a magnet ($A.m = e.c$). A Magnetic monopole [4] is a hypothetical particle that is a magnet with only 1 pole. A dimensionless geometrical formula for a magnetic monopole σ_e and electron E_σ is proposed.

$$\sigma_e = \frac{2.\pi^2}{3.\alpha^2.e_x.c_x} = A.(m/s).s = A.m \quad (15)$$

$$E_\sigma = t_x.\sigma_e^3 \quad (16)$$

nb. the conversion of Planck time t_p, elementary charge e and speed of light c to SI units $1s, 1C, 1m/s$ requires dimensionless numbers which are numerically equivalent (t_x, e_x, c_x).

$$\frac{t_p}{t_x} = \frac{5.3912...e^{-44}s}{5.3912...e^{-44}} = 1s$$

$$\frac{e}{e_x} = \frac{1.6021764...e^{-19}C}{1.6021764...e^{-19}} = 1C$$

$$\frac{c}{c_x} = \frac{299792458m/s}{299792458} = 1m/s$$

Planck mass:

$$m_e = m_P.E_\sigma \quad (17)$$

Compton wavelength:

$$\lambda_e = \frac{2.\pi.l_p}{E_\sigma} \quad (18)$$

Frequency:

$$T_e = \frac{2.\pi.l_p}{E_\sigma.c} = \frac{t_p}{E_\sigma} = \frac{1}{\sigma_e^3}.\frac{t_p}{t_x} \quad (19)$$

Gravitation coupling constant:

$$\alpha_G = (\frac{m_P.E_\sigma}{m_P})^2 = E_\sigma^2 \quad (20)$$

para-positronium lifetime:

$$t_0 = \frac{\alpha^5}{\sigma_e^3}.\frac{t_p}{t_x} \quad (21)$$

ortho-positronium lifetime:

$$t_1 = \frac{9.\pi.\alpha^6}{2.\sigma_e^3.(\pi^2 - 9)}.\frac{t_p}{t_x} \quad (22)$$

Up-quark

$$\sigma^2$$

Down quark

$$\sigma^{-1}$$

9 Bohr magneton

$$\mu = \frac{e.h.n}{4.\pi.m_e} = \frac{8.m_P.l_p^2.c^3}{\alpha.Q^3.m_e} = \frac{A_Q.l_p^2}{E_\sigma} = \frac{A_Q.l_p.c}{\sigma_e^3}.\frac{t_p}{t_x} \quad (23)$$

$$\mu = A.m^2$$

10 Reduced formulas

Replacing l_p with eqn.14, the natural constants can be reduced to Q, α, c

$$h = \frac{2^2.5^7.\pi^3.\alpha.Q^{10}}{c^5} \tag{24}$$

$$e = \frac{2^4.5^7.\pi.Q^5}{c^3} \tag{25}$$

$$m_e = m_P.\frac{\pi^4}{2^8.3^3.5^{14}.\alpha^5.Q_x^7} \tag{26}$$

The Rydberg constant R_∞

$$R_\infty = \frac{m_e.e^4.\mu_0^2.c^3}{8.h^3} = \frac{\pi^2.c^5}{2^{10}.3^3.5^{21}.\alpha^8.Q^8.Q_x^7} \tag{27}$$

11 Quintessence momentum

The Rydberg constant, with a 12-digit precision
R_∞ = 10 973 731.568 539(55) [5]
is the most accurate of the natural constants. consequently we may re-define Q in terms of this constant.

$$Q^{15} = \frac{\pi^2.c^5}{2^{10}.3^3.5^{21}.\alpha^8.R_\infty} \tag{28}$$

$$Q = (\frac{\pi^2.c^5}{2^{10}.3^3.5^{21}.\alpha^8.R_\infty})^{\frac{1}{15}} \tag{29}$$

12 von Klitzing constant

The von Klitzing constant reduces to α and c.

$$R_K = \frac{h}{e^2} = \frac{\pi.\alpha.c}{5000000} \tag{30}$$

R_K = 25812.807 557(18) [17]

$$\alpha = 137.035\ 999\ 677(96)$$

1. $(17^4 + 11)/(1 + \sqrt{5})$ = 25812.807 574...

$$\alpha = (17^4 + 11)/(c.\phi.\mu_0) = 137.035\ 999\ 768\ 293...$$

As example:
Electron magnetic moment = 1.001 159 652 180 73(25)

$$g = 1 + \frac{1}{2.\pi.\alpha} - \frac{1}{3.\pi^2.\alpha^2} + \frac{1}{3.\pi.\alpha^3} - \frac{1}{\pi^2.\alpha^4} + \frac{1}{\pi.\alpha^5}... \tag{31}$$

$$g = 1.001\ 159\ 652\ 180\ 711$$

2. James Gilson [18]

$$\alpha = 137.035\ 999\ 786\ 699...$$

13 Temperature

When an Ampere travels at the speed of light we have Planck temperature; defining a Kelvin -Q K_Q temperature scale with mKsa units.

$$T_P = \frac{8.c^4}{\pi.\alpha.Q^3} = \frac{A_Q.c}{\pi}; units = K_Q \tag{32}$$

$$T_P = A.m/s$$

Boltzmann's constant k_B

$$k_B = \frac{E_p}{T_P} = \frac{\pi^2.\alpha.Q^5}{4.c^3}; units = J/K_Q \tag{33}$$

Where $1K_Q\ x\ 1.0008254 = 1K$. By convention the water boiling point has been set: 100C at 101.325 kPa (standard pressure). If we set standard temperature - pressure where 100C at 102.2 kPa, then we can replace K with an mKsa unit K_Q [20].

14 Numerical solutions

CODATA 2010 values
α = 137.035 999 074(44) [7]
R_∞ = 10 973 731.568 539(55) [5]
h = 6.626 069 57(29) $e-34$ [6]
e = 1.602 176 565(35) $e-19$ [9]
m_e = 9.109 382 91(40) $e-31$ [10]
G = 6.673 84(80) $e-11$ [12]
$\mu_0 = 4.\pi/10^7$
k_B = 1.380 6488(13) $e-23$ [13]

Using α = 137.035 999 074 gives
h = 6.626 069 148 $e-34$
e = 1.602 176 513 $e-19$
m_e = 9.109 382 323 $e-31$
G = 6.672 497 199 $e-11$
R_∞ = 10 973 731.568 539
$\mu_0 = 4.\pi/10^7$

All results agree with experimental CODATA values except for G. However the same calculated values were used to solve Planck constant, the electron wavelength and electron mass and so by extension the Rydberg constant; and these 4 values all have the requisite precision. We may also note that the calculated G agrees with the Sandia National Laboratories G;

Parks et al G = 6.672 34(21) $e-11$ [14]

Refer to the website [19] for further details and a complete list of calculated constants.

15 Summary

The 3 units of motion; Planck momentum, Planck time and c formed the mass domain. From the sqrt of Planck momentum Q, c and alpha was formed an ampere. From this ampere, Planck time and c was formed the charge domain which includes particles and particle properties. As only the ampere formula was hypothesised, i.e.: the other formulas were all derived, and as the ampere has a simple cubic geometry, and as all results are within CODATA precision, I argue that the significance of this approach cannot be easily dismissed as numerology but rather deserves futher analysis.

A universe whose dimensions are motion also suggests a Planck unit theory and a Mathematical Universe Hypothesis MUH for particles and photons reduce to modulated units of momentum that dictate the frequency of Planck events. Wave-particle duality then becomes a analog electric wave-state (the particle frequency) to digital Planck-mass point-state oscillation, both formulas, mass mc2 and energy hv, are thereby functions of particle frequency, and so by altering this frequency [19], we may freely adjust particle mass and wavelength with respect to the 2 universal constants Planck time and c. Relativity then reduces to geometry [21].

16 Reference formulas

These formulas are cross referenced with common formulas

$$\alpha = \frac{2.h}{\mu_0.e^2.c}$$

$$2\ 2.\pi.Q^2.2.\pi.l_p\ \frac{32.l_p.c^5}{\pi^2.\alpha.Q^8}\ \frac{\alpha^2.Q^6}{256.l_p^2.c^4}\ \frac{1}{c}$$

$$\alpha = \alpha \tag{34}$$

$$c = \frac{1}{\sqrt{\mu_0.\epsilon_0}}$$

$$\mu_0.\epsilon_0 = \frac{\pi^2.\alpha.Q^8}{32.l_p.c^5}\ \frac{32.l_p.c^3}{\pi^2.\alpha.Q^8} = \frac{1}{c^2}$$

$$c = c \tag{35}$$

$$R_\infty = \frac{m_e.e^4.\mu_0^2.c^3}{8.h^3}$$

$$m_e\ \frac{65536.l_p^4.c^8}{\alpha^4.Q^{12}}\ \frac{\pi^4.\alpha^2.Q^{16}}{1024.l_p^2.c^{10}}\ c^3\ \frac{1}{8}\ \frac{1}{8.\pi^3.Q^6.8.\pi^3.l_p^3}$$

$$R_\infty = \frac{m_e}{4.\pi.l_p.\alpha^2.m_P} \tag{36}$$

$$E_n = -\frac{2.\pi^2.k_e^2.m_e.e^4}{h^2.n^2}$$

$$2.\pi^2\ \frac{\pi^2.\alpha^2.Q^{16}}{16384.l_p^2.c^6}\ m_e\ \frac{65536.l_p^4.c^8}{\alpha^4.Q^{12}}\ \frac{1}{4.\pi^2.Q^4.4.\pi^2.l_p^2}$$

$$E_n = -\frac{m_e.c^2}{2.\alpha^2.n^2} \tag{37}$$

$$q_p = \sqrt{4.\pi.\epsilon_0.\hbar.c}$$

$$q_p = \sqrt{4.\pi\ \frac{32.l_p.c^3}{\pi^2.\alpha.Q^8}\ 2.\pi.Q^2.l_p\ c} = \sqrt{\alpha}.e \tag{38}$$

$$r_e = \frac{e^2}{4.\pi.\epsilon_0.m_e.c^2}$$

$$r_e = \frac{256.l_p^2.c^4}{\alpha^2.Q^6}\ \frac{1}{4.\pi}\ \frac{\pi^2.\alpha.Q^8}{32.l_p.c^3}\ \frac{1}{m_e.c^2} = \frac{l_p.m_P}{\alpha.m_e} \tag{39}$$

$$m_e = \frac{B^2.r^2.e}{2.V}$$

$$V_p = \frac{E_p}{e}$$

$$\frac{B^2.r^2.e^2}{E_p} = \frac{\pi^2.\alpha^2.Q^{10}}{64.l_p^4.c^4}\ l_p^2\ \frac{256.l_p^2.c^4}{\alpha^2.Q^6}\ \frac{1}{2.\pi.Q^2.c}$$

$$\frac{B^2.r^2.e^2}{E_p} = m_P \tag{40}$$

Maple code:

```
pi := 3.14159265358979323846264 :
c := 299792458 :
a := 137.035999074 :
R := 10973731.568539 :

Q := (pi^2 * c^5/(2^10 * 3^3 * 5^21 * a^8 * R))^(1/15) :
lp := (5^7 * pi * a * Q^8/c^5) :
mP := (2 * pi * Q^2/c) :
tp := 2 * lp/c :

G = c^2 * lp/mP
e = 16 * lp * c^2/(a * Q^3)
h = 2 * pi * Q^2 * 2 * pi * lp
m_e = mP * tp * (pi^2 * Q^3/(24 * a * lp * c^3))^3
```

References

1. SciAm 06/05, P57: Constants, J Barrow, J Webb
2. hyperphysics.phy-astr.gsu.edu/hbase/electric/elefie.html
3. http://en.wikipedia.org/wiki/Planck-force
4. en.wikipedia.org/wiki/Magnetic-monopole
5. http://physics.nist.gov/cgi-bin/cuu/Value?ryd
6. http://physics.nist.gov/cgi-bin/cuu/Value?ha
7. http://physics.nist.gov/cgi-bin/cuu/Value?alphinv
8. http://physics.nist.gov/cgi-bin/cuu/Value?plkl
9. http://physics.nist.gov/cgi-bin/cuu/Value?e
10. http://physics.nist.gov/cgi-bin/cuu/Value?me
11. http://physics.nist.gov/cgi-bin/cuu/Value?mu0
12. http://physics.nist.gov/cgi-bin/cuu/Value?bg
13. http://physics.nist.gov/cgi-bin/cuu/Value?k
14. Parks, H. V, Faller, J. E. Phys. Rev. Lett. http://xxx.lanl.gov/abs/1008.3203 (2010)
15. A. M. Jeffery, R. E. Elmquist, L. H. Lee, J. Q. Shields, and R. F. Dziuba, IEEE Trans. Instrum. Meas. 46, 264, (1997).
16. http://www.nature.com/nature/journal/v473/n7348/full/nature10104.html
17. A. Tzalenchuk et al, Towards a quantum resistance standard based on epitaxial graphene, Nature Nanotechnology 5, 186 - 189 (2010)
18. http://www.fine-structure-constant.org/page5A.html
19. http://www.planckmomentum.com/
20. private correspondence (Marian Gheorghe)
21. M. J. Macleod, Plato's Code: the geometry of momentum (2013 edition)
    http://www.platoscode.com