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

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A geometrical relationship between the charge constants, the fine structure constant alpha and the sqrt of Planck momentum is used to define G, h, e and m_e in terms of the 4 most accurate natural constants c, α, R and μ_0. As c and μ_0 have exact values and the Rydberg constant R is precise to 12 digits, the accuracy of the calculated values for G, h, e and m_e is limited only by the precision of α. Results consistent with CODATA 2010 suggest a digital Planck unit theory.

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 as $2.\pi.Q^2$ gives [2]

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

3 Mass constants

Replacing Planck mass with Planck momentum, 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

(Proposed) Ampere A_Q as volume of velocity per momentum

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

5 Elementary charge

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

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

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 2.10^{-7} newton per meter of length.

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

gives:

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

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

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

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

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

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

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

8 Electron as magnetic monopole

m_e in terms of $m_P,\ t_p,\ \alpha,\ e,\ c$. [6]

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 [5] is a hypothetical particle that is a magnet with only 1 pole. A dimensionless geometrical formula for a magnetic monopole σ_e is proposed.

$$\sigma_e = \frac{2.\pi^2}{3.\alpha^2.e_x.c_x} \tag{15}$$

$$E_\sigma = t_x.\sigma_e^3 \tag{16}$$

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 units:

$$m_e = m_P.E_\sigma \tag{17}$$

$$\lambda_e = \frac{2.\pi.l_p}{E_\sigma} \tag{18}$$

The above suggests that particles are dimensionless functions (mathematical formulas) that dictate the frequency of digital (integer) Planck units. If all charged particles derive from magnetic monopoles σ_e , all charges must be of equal magnitude, furthermore, the $E_\sigma = \sigma_e^3$ fraction suggests a magnetic monopole basis for the quark.

9 Bohr magneton

$$\lambda_e = \frac{m_P.l_p}{m_e} \tag{19}$$

$$\mu = \frac{e.h.n}{4.\pi.m_e} = \frac{8.m_P.l_p^2.c^3}{\alpha.Q^3.m_e} = A_Q.l_p.\lambda_e = \frac{A_Q.l_p^2}{E_\sigma} \tag{20}$$

We may note that π does not appear in the formula (area = l_p^2), and so the Bohr magneton ($A.m^2$) may be a Planck event whose frequency is dictated by the frequency of the electron.

10 Reduced formulas

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

$$h = \frac{2^2.5^7.\pi^3.\alpha.Q^{10}}{c^5} \tag{21}$$

$$e = \frac{2^4.5^7.\pi.Q^5}{c^3} \tag{22}$$

$$m_e = m_P.\ \frac{\pi^4}{2^8.3^3.5^{14}.\alpha^5.Q_x^7} \tag{23}$$

The Rydberg constant R_∞

$$R_\infty = \frac{m_e.e^4.\mu_0^2.c^3}{8.h^3} = \frac{\pi^2.c^5}{2^{10}.3^3.5^{21}.\alpha^8.Q^8.Q_x^7} \tag{24}$$

11 Fine structure constant

The Rydberg constant has a 12-digit precision, consequently we may re-define Q in terms of this constant.

$$Q^{15} = \frac{\pi^2.c^5}{2^{10}.3^3.5^{21}.\alpha^8.R_\infty} \tag{25}$$

Using the Rydberg CODATA mean value

$$Q = (\frac{\pi^2.c^5}{2^{10}.3^3.5^{21}.\alpha^8.10973731.568539})^{\frac{1}{15}} \tag{26}$$

As c has a fixed value, our least accurate constant is now α.

12 Numerical solutions

CODATA 2010 values
α = 137.035 999 074(44) [9]
R_∞ = 10 973 731.568 539(55) [7]
h = 6.626 069 57(29) $e-34$ [8]
e = 1.602 176 565(35) $e-19$ [11]
m_e = 9.109 382 91(40) $e-31$ [12]
G = 6.673 84(80) $e-11$ [14]
$\mu_0 = 4.\pi/10^7$

Maple code:

$pi := 3.14159265358979323846 26 :$

$c := 299792458 :$

$a := 137.035999074 :$

$Q := (pi^2 * c^5/(2^{10} * 3^3 * 5^{21} * a^8 * 10973731.568539))^{(1/15)} :$

$lp := (5^7 * pi * a * Q^8/c^5) :$

$mP := (2 * pi * Q^2/c) :$

$tp := 2 * lp/c :$

$G = c^2 * lp/mP$

$e = 16 * lp * c^2/(a * Q^3)$

$h = 2 * pi * Q^2 * 2 * pi * lp$

$m_e = mP * tp * (pi^2 * Q^3/(24 * a * lp * c^3))^3$

Using $\alpha = 137.035\,999\,074$ gives

$h = 6.626\,069\,148\; e - 34$

$e = 1.602\,176\,513\; e - 19$

$m_e = 9.109\,382\,323\; e - 31$

$G = 6.672\,497\,199\; e - 11$

$R_\infty = 10\,973\,731.568\,539$

$\mu_0 = 4.\pi/10^7$

Refer to online calculator for complete list of constants [18]
nb. Parks et al (Sandia National Laboratories) [15]

$G = 6.672\,34(21)\; e - 11$

13 Summary

By proposing the sqrt of Planck momentum as the link between mass and charge, it is possible to reduce the natural constants to simple geometrical shapes and solve in terms of the 4 most accurate constants. Particles become dimensionless formulas that dictate the frequency of Planck events suggesting that wave-particle duality may be an analog wave state to digital Planck unit/ Planck time point state oscillation.

14 Reference formulas

These formulas are cross referenced with common formulas

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

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

$$\alpha = \alpha \tag{27}$$

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

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

$$c = c \tag{28}$$

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

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

$$R_\infty = \frac{m_e}{4.\pi.l_p.\alpha^2.m_P} \tag{29}$$

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

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

$$E_n = -\frac{m_e.c^2}{2.\alpha^2.n^2} \tag{30}$$

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

$$q_p = \sqrt{4.\pi \; \frac{32.l_p.c^3}{\pi^2.\alpha.Q^8} \; 2.\pi.Q^2.l_p \; c} = \sqrt{\alpha}.e \tag{31}$$

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

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

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

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

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

$$\frac{B^2.r^2.e^2}{E_p} = m_P \tag{33}$$

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