a Planck unit theory
sqrt of Planck momentum as a link between mass and charge

Malcolm J. Macleod

e-mail: maclem@planckmomentum.com

In this article I propose the sqrt of Planck momentum, denoted here as Q, as a link between the mass constants and the charge constants. Formulas for the fundamental physical constants are derived as geometrical shapes in terms of Q, the Sommerfeld fine structure constant alpha (11-12 digit precision), the vacuum of permeability (exact value) and the speed of light (exact value). The electron is solved using magnetic monopoles which then permits a solution for the Rydberg constant R, the most accurate natural constant (12-13 digits). We can then define Q in terms of R, and so the numerical solutions for the physical constants are limited only by the precision of the fine structure constant. Solutions for the constants in terms of R, c, μ_0, α given in table below.

	Calculated (R, c, μ_0, α) [3]	CODATA 2014
speed of light	(299792458)	c = 299792458 (exact)
Fine structure constant	(137.035999139)	α = 137.035 999 139(31) [9]
Rydberg constant	(10973731.568508)	R_∞ = 10 973 731.568 508(65) [7]
Planck constant	h^* = .662 606 913 413 e-33	h = .662 607 004 0(81) e-33 [8]
Elementary charge	e^* = .160 217 651 130 e-18	e = .160 217 662 08(98) e-18 [11]
Vacuum permeability	$(4\pi/10^7)$	$\mu_0 = 4\pi/10^7$, (exact) [14]
Electron mass	m_e^* = .910 938 231 256 e-30	m_e = .910 938 356(11) e-30 [13]
Electron wavelength	λ_e^* = .242 631 023 66 e-11	λ_e = .242 631 023 67(11) e-11 [12]
Boltzmann's constant	k_B^* = .137 951 014 752 e-22	k_B = .138 064 852(79) e-22 [16]
Larmor frequency	f_L = 28 024.953 551	f_L = 28 024.951 64(17) [20]
Gravitation constant	G^* = .667 249 719 229 e-10	G = .667 408(31) e-10 [15]
Von Klitzing constant	R_K^* = 25 812.807 455 591	R_K = 25 812.807 455 5(59) [18]
Bohr magneton	μ_B^* = .927 400 936 03e-23	μ_B = .927 400 999 (57)e-26 [21]

keywords: Planck unit theory, sqrt of Planck momentum, magnetic monopole electron, fundamental physical constants, fine structure constant alpha, Rydberg constant, Quintessence;

1 Introduction

In this article I have denoted the letter Q (as in Quintessence) to represent the sqrt of Planck momentum such that Planck momentum = $2\pi Q^2$;

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

I then define the mass and the charge constants in terms of this Q. These formulas give a solution for the permeability of vacuum μ_0 via which we can now define Planck length l_p in terms of μ_0, Q, c, α.

From a proposed solution for magnetic monopoles using (α, c, e), I construct a formula for the frequency of the electron. This in turn suggests a Planck unit theory whereby the electron determines the frequency of Planck events. The electron mass then gives a solution for the Rydberg constant R, the most precise of the natural constants (12-13 digits).

The precision of Planck momentum is low (4-5 digits), and so I replace Q with R. The physical constants can now be defined in terms of R, c, μ_0, α. Results are listed in the table above.

2 Mass constants

Typically the 'mass' constants as Planck units are defined using Planck mass m_P. Here I replace Planck mass with Planck momentum $2\pi Q^2$;

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

$$G = \frac{l_p c^3}{2\pi Q^2},\ units = m.\frac{m^3}{s^3}.\frac{s}{kg.m} \tag{3}$$

$$h = 2\pi Q^2 2\pi l_p,\ units = \frac{kg.m}{s}.m \tag{4}$$

$$t_p = \frac{2l_p}{c},\ units = m.\frac{s}{m} \tag{5}$$

$$F_p = \frac{E_p}{l_p} = \frac{2\pi Q^2}{t_p},\ units = \frac{kg.m}{s}.\frac{1}{s} \tag{6}$$

3 Ampere

I proposed an Ampere A_Q using Q^3

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

whereby;
Planck Temperature from; AV = $A_Q c$
Elementary charge from; AT = $A_Q t_p$
Magnetic monopole from; AL = $A_Q l_p$
Electron frequency from; T(AL)^3

4 Elementary charge

$$e = AT = A_Q t_p$$

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

5 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.

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

gives:

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

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

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

for example;

$$\alpha = \frac{2h}{\mu_0 e^2 c} = 2.2\pi Q^2 2\pi l_p.\frac{32 l_p c^5}{\pi^2\alpha Q^8}.\frac{\alpha^2 Q^6}{256 l_p^2 c^4}.\frac{1}{c} = \alpha \tag{13}$$

$$\mu_0\epsilon_0 = \frac{\pi^2\alpha Q^8}{32 l_p c^5}.\frac{32 l_p c^3}{\pi^2\alpha Q^8} = \frac{1}{c^2} \tag{14}$$

$$c = \frac{1}{\sqrt{\mu_0\epsilon_0}} = c \tag{15}$$

6 Planck length l_p

l_p in terms of $Q,\ \alpha,\ c$.
The magnetic constant has a fixed value $\mu_0 = 4\pi/10^7$ (eq.10)

$$l_p = \frac{\pi^2\alpha Q^8}{32\mu_0 c^5} \tag{16}$$

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

$$l_p = \frac{5^7\pi\alpha Q^8}{c^5} \tag{17}$$

for example, replacing Planck length gives;

$$h = 2\pi Q^2 2\pi l_p = \frac{2^2 5^7 \pi^3 \alpha Q^{10}}{c^5} \tag{18}$$

$$e = \frac{16 l_p c^2}{\alpha Q^3} = \frac{2^4 5^7 \pi Q^5}{c^3} \tag{19}$$

$$G = \frac{l_p c^3}{2\pi Q^2} = \frac{5^7 \alpha Q^6}{2c^2} \tag{20}$$

7 von Klitzing constant

The von Klitzing constant reduces to α and c and so has the potential to provide the most definitive solution for α [1].

$$R_K = \frac{h}{e^2} = \frac{\pi\alpha c}{5000000} \tag{21}$$

R_K = 25812.807 455 5(59) [2]

$$\alpha = 137.035\ 999\ 139$$

8 Electron as magnetic monopole

The ampere-meter (Ampere-Length) is the SI unit for pole strength (the product of charge and velocity) in a magnet ($AL = A_Q l_p = ec$). A Magnetic monopole [6] is a hypothetical particle that is a magnet with only 1 pole. The proposed monopole σ_e [4].

$$\sigma_e = \frac{2\pi^2}{3\alpha^2 ec} \tag{22}$$

The electron frequency f_e;

$$f_e = t_p\sigma_e^3 = \frac{\pi^6 Q^9}{2^8 3^3 \alpha^3 l_p^2 c^{10}} = \frac{\pi^4}{2^8 3^3 5^{14} \alpha^5 Q^7} \tag{23}$$

Electron mass:

$$m_e = m_P f_e \tag{24}$$

Electron wavelength:

$$\lambda_e = \frac{2\pi l_p}{f_e} \tag{25}$$

Gravitation coupling constant:

$$\alpha_G = (\frac{m_e}{m_P})^2 = f_e^2 \tag{26}$$

Magnetic Induction

$$B_e = \frac{m_P}{\alpha^2 A_Q t_p^2} f_e^2 \tag{27}$$

Rydberg constant R_∞

$$R_\infty = \frac{m_e e^4 \mu_0^2 c^3}{8h^3} = \frac{\pi^2 c^5}{2^{10} 3^3 5^{21} \alpha^8 Q^{15}} \tag{28}$$

The Rydberg constant R_∞ = 10973731.568508(65) [7] 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(28) we may now rationalize Q in terms of the 4 most accurate constants, c (exact value), μ_0 (exact value), R and alpha;

$$Q^{15} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi\alpha^8 R} \tag{29}$$

9 Constants from R, c, α, μ_0

Planck constant

$$h = \frac{2^2 5^7 \pi^3 \alpha Q^{10}}{c^5} \tag{30}$$

$$h^3 = \frac{2\pi^{10}\mu_0^3}{3^6 c^5 \alpha^{13} R^2} \tag{31}$$

Elementary charge

$$e = \frac{2^4 5^7 \pi Q^5}{c^3} \tag{32}$$

$$e^3 = \frac{4\pi^5}{3^3 c^4 \alpha^8 R} \tag{33}$$

Boltzmann constant

$$T_P = \frac{A_Q c}{\pi} = \frac{8c^4}{\pi \alpha Q^3} \tag{34}$$

$$k_B = \frac{E_P}{T_P} = \frac{\pi^2 \alpha Q^5}{4c^3} \tag{35}$$

$$k_B^3 = \frac{\pi^5 \mu_0^3}{3^3 2 c^4 \alpha^5 R} \tag{36}$$

Gravitation constant

$$G = \frac{c^2 l_p}{m_P} \tag{37}$$

$$G^5 = \frac{\pi^3 \mu_0}{2^{20} 3^6 \alpha^{11} R^2} \tag{38}$$

Electron mass

$$m_e^3 = \frac{16\pi^{10} R \mu_0^3}{3^6 c^8 \alpha^7} \tag{39}$$

Electron wavelength

$$\lambda_e = \frac{1}{2\alpha^2 R} \tag{40}$$

Planck length

$$l_p = \frac{5^7 \pi \alpha Q^8}{c^5} \tag{41}$$

$$l_p^{15} = \frac{\pi^{22} \mu_0^9}{2^{35} 3^{24} c^{35} \alpha^{49} R^8} \tag{42}$$

Planck mass

$$m_P = \frac{2\pi Q^2}{c} \tag{43}$$

$$m_P^{15} = \frac{2^{25} \pi^{13} \mu_0^6}{3^6 c^5 \alpha^{16} R^2} \tag{44}$$

Ampere

$$A_Q = \frac{8c^3}{\alpha Q^3} \tag{45}$$

$$A_Q^5 = \frac{2^{10} \pi 3^3 c^{10} \alpha^3 R}{\mu_0^3} \tag{46}$$

A dimensional analysis of these formulas is discussed in the article on the Mathematical Universe [5].

10 Summary

I have proposed that the sqrt of Planck momentum is a link between the mass and charge domains that can be used to build geometrical relationships for the physical constants G, h, e, k_B, m_e... in terms of Rydberg constant R, the speed of light c, the vacuum permeability μ_0 and α the fine structure constant. This then permits a solution for these constants whose precision is limited only by α, the least precise of those 4 constants.

The electron formula (in terms of magnetic monopoles) suggests a Planck unit theory where the particle frequency dictates the frequency of the corresponding Planck units. For example, electron mass becomes the frequency of occurrence of a unit of Planck mass as dictated by the electron frequency. By reducing the electron frequency we can accordingly increase the frequency of units of Planck mass and so increase the measured electron mass. This in turn suggests that relativistic mass is a function of frequency.

References

1. A. M. Jeffery, R. E. Elmquist, L. H. Lee, J. Q. Shields, and R. F. Dziuba, IEEE Trans. Instrum. Meas. 46, 264, (1997).
2. A. Tzalenchuk et al, Towards a quantum resistance standard based on epitaxial graphene, Nature Nanotechnology 5, 186 - 189 (2010)
3. Online physical constants calculator http://www.planckmomentum com/momentum/
4. Electron as magnetic monopole http://www.planckmomentum com/electron/
5. A Mathematical Universe Hypothesis http://www.planckmomentum com/muh/
6. Magnetic monopole en.wikipedia.org/wiki/Magnetic-monopole (10/2015)
7. Rydberg constant http://physics.nist.gov/cgi-bin/cuu/Value?ryd
8. Planck constant http://physics.nist.gov/cgi-bin/cuu/Value?ha
9. Fine structure constant http://physics.nist.gov/cgi-bin/cuu/Value?alphinv
10. Planck length http://physics.nist.gov/cgi-bin/cuu/Value?plkl
11. Elementary charge http://physics.nist.gov/cgi-bin/cuu/Value?e
12. Electron wavelength http://physics.nist.gov/cgi-bin/cuu/Value?ecomwl
13. Electron charge http://physics.nist.gov/cgi-bin/cuu/Value?me

14. Vacuum of permeability
http://physics.nist.gov/cgi-bin/cuu/Value?mu0
15. Gravitation constant
http://physics.nist.gov/cgi-bin/cuu/Value?bg
16. Boltzmann constant
http://physics.nist.gov/cgi-bin/cuu/Value?k
17. Free electron gyromagnetic constant
http://physics.nist.gov/cgi-bin/cuu/Value?gammaebar
18. Von Klitzing constant
http://physics.nist.gov/cgi-bin/cuu/Value?rk
19. Electron wavelength
http://physics.nist.gov/cgi-bin/cuu/Value?ecomwl
20. Larmor frequency
http://physics.nist.gov/cgi-bin/cuu/Value?gammaebar
21. Bohr magneton
http://physics.nist.gov/cgi-bin/cuu/Value?mub