A virtual black-hole electron and the sqrt of Planck momentum

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In this article the sqrt of Planck momentum is applied as a distinct Planck unit and is used as a link between the mass constants and the charge (electric) constants. From these constants, formulas for a magnetic monopole (AL = ampere-meter) and an electron frequency \( f_e (\text{AL})^3 / T \) are constructed. The electron is seen as oscillating between an electric-state whose duration in units of Planck time \( t_p \) is dictated by \( f_e \), and a mass-state whose duration equals to (or is defined by) 1 Planck time \( T \). The premise being that after 1 oscillation cycle the magnetic monopoles (AL) combine with time \( T \) and cancel, \( f_e \) units = (AL) \( ^3 / T \) = 1, exposing for 1 \( t_p \) the mass-state black-hole electron center. The SI units \( kg, m, s, A, K \) are thus not independent but overlap and cancel in this electron frequency ratio. This permits us to reduce the number of required units to 2 and develop relationships between the fundamental physical constants. For example, we can define the least precise constants \( G, h, e, m_e, k_g \) in terms of the most precise \( c, \mu_0 \) (exact values), the fine structure constant alpha \((10-12\) digits) and the Rydberg constant \((12-13\) digits). Results are consistent with CODATA 2014 (table). This thus becomes a Planck unit theory where the dimensionless electron formula \( f_e \) dictates the frequency of Planck events, i.e.: electron mass as the frequency of occurrence of units of Planck mass.

Table 1

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Calculated ( (\alpha, \pi, \beta) )</th>
<th>CODATA 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planck constant</td>
<td>( h = 6.626 069 134 e-34 u_\pi )</td>
<td>( h = 6.626 070 040(81) e-34 ) [4]</td>
</tr>
<tr>
<td>Elementary charge</td>
<td>( e' = 1.602 176 531 30 e-19 u_\pi )</td>
<td>( e = 1.602 176 6208(98) e-19 ) [7]</td>
</tr>
<tr>
<td>Electron mass</td>
<td>( m_e = 9.109 382 312 56 e-31 m_\pi )</td>
<td>( m_e = 9.109 383 56(11) e-31 ) [9]</td>
</tr>
<tr>
<td>Boltzmann’s constant</td>
<td>( k_b = 1.379 510 147 32 e-23 m_\pi )</td>
<td>( k_b = 1.380 648 52(79) e-23 ) [12]</td>
</tr>
<tr>
<td>Gravitation constant</td>
<td>( G = 6.672 497 192 29 e-11 m_\pi )</td>
<td>( G = 6.674 08(31) e-11 ) [11]</td>
</tr>
</tbody>
</table>

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

1 Sqrt of Planck momentum

In this section I introduce the sqrt of momentum as a distinct Planck unit and suggest how this could be used as a link between the mass and charge domains.

From the formulas for the charge constants I then derive a formula for a magnetic monopole (ampere-meter AL) and from this subsequently a formula for an electron function \( f_e \).

The electron formula is constructed from monopoles (AL) and from time \( T \) yet it is also dimensionless as the charge and time units are not independent but rather are related, collapsing within the electron whereby: \( f_e \) = (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 \( \alpha \sim 137.036 \).

1.1 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:

\[ Q = 1.019 113 411..., \text{ unit } = q \]  

Planck momentum; \( 2\pi Q^2, \text{ units } = q^2 \),
Planck length; \( l_p, \text{ units } = m = q^2 s/kg, \)
\( c, \text{ units } = m/s = q^2 / kg; \)

1.2. In Planck terms the mass constants are typically defined in terms of Planck mass, here I use Planck momentum:

\[ m_p = \frac{2\pi Q^2}{c}, \text{ unit } = kg \]

\[ E_p = m_p c^2 = 2\pi Q^2 c, \text{ units } = \frac{kg.m^2}{s^2} = \frac{q^4}{kg} \]

\[ t_p = \frac{2l_p}{c}, \text{ unit } = s \]

\[ F_p = \frac{2\pi Q^2}{t_p}, \text{ units } = \frac{q^2}{s} \]

1.3. The charge constants in terms of \( Q^4, c, \alpha, l_p, \):

\[ A_Q = \frac{8c^3}{\alpha Q^3}, \text{ unit } A = \frac{m^3}{q^3 s^3} = \frac{q^3}{kg^3} \]

\[ e = A_Q l_p = \frac{8c^3}{\alpha Q^3} \cdot \frac{2l_p}{c} = \frac{16l_p c^2}{\alpha Q^3}, \text{ units } = A.s = \frac{q^5}{kg^3} \]

\[ T_p = \frac{A_Q c}{\pi} = \frac{8c^3}{\alpha Q^3} \cdot \frac{c}{\pi} = \frac{8c^4}{\alpha Q^3}, \text{ units } = \frac{q^5}{kg^3} \]

\[ k_g = \frac{E_p}{T_p} = \frac{\pi^2 \alpha Q^2}{4c^3}, \text{ units } = \frac{kg}{q} \]
1.4. As with c, the permeability of vacuum \( \mu_0 \) 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 \( 2 \times 10^{-7} \) newton per meter of length.

\[
F_{\text{electric}} = \frac{F_p}{\alpha A_0} = \frac{2 \pi Q^2}{\alpha t_r} \left( \frac{\alpha Q^3}{8e^2} \right)^2 = \frac{\pi \alpha Q^8}{64t_r c^5} = \frac{2}{10^7}
\]

(10)

\[
\mu_0 = \frac{\pi^2 \alpha Q^8}{32 t_r c^5} = \frac{4 \pi}{10^7}, \quad \text{units} = \frac{kg.m}{s^2 A^2} = \frac{kg^6}{q^4 s^2}
\]

(11)

1.5. Rewriting Planck length \( l_p \) in terms of \( Q, c, \alpha, \mu_0 \):

\[
l_p = \frac{\pi^2 \alpha Q^8}{32 \mu_0 c^5}, \quad \text{unit} = \frac{q^5 s}{kg} = m
\]

(12)

1.6. A magnetic monopole in terms of \( Q, c, \alpha, l_p \):

The ampere-meter is the SI unit for pole strength (the product of charge and velocity) in a magnet (\( Am = ec \)). A magnetic monopole \( \sigma_g \) is a hypothetical particle that is a magnet with only 1 pole [2]. I propose a magnetic monopole \( \sigma_t \) from \( c, c, \alpha, \sigma_\epsilon \) (\( \sigma_\epsilon = 0.13708563 \times 10^{-6} \));

\[
\sigma_t = \frac{3a^2 c \epsilon_0}{2 \pi^2}, \quad \text{units} = \frac{q^5 s}{kg^6}
\]

(13)

I then use this monopole to construct an electron frequency function \( f_e = f_e \) (\( f_e = 0.2389545 \times 10^{23} \));

\[
f_e = \frac{c^3}{l_p} = \frac{2 \pi^6 \alpha Q^8}{\pi^2 Q^8} = \frac{3 \alpha^5 Q^7}{4 \pi^2 \mu_0}, \quad \text{units} = \frac{q^{15} s^2}{kg l^2}
\]

(14)

1.7. The most precisely measured of the natural constants is the Rydberg constant \( R_\infty \) (see table) and so it is important to this model. The unit for \( R_\infty \) is \( 1/m \). For \( m_e \) see eq(22);

\[
R_\infty = \frac{m e^2 \mu_0 c^3}{8 \epsilon_0} = \frac{2 \pi^5 \mu_0}{3 \pi \alpha Q^15}, \quad \text{units} = \frac{1}{m} = \frac{kg^{13}}{q^{17} s^3}
\]

(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;

\[
m = \frac{q^2 s}{kg} \frac{q^{15} s^2}{kg^{12}} = \frac{q^{17} s^3}{kg^{13}} \quad \text{thus} \quad \frac{q^{15} s^2}{kg^{12}} = 1
\]

(16)

and so we can further reduce the number of units required, for example we can define \( s \) in terms of \( kg, q \);

\[
s = \frac{kg^6}{q^{15/2}}
\]

(17)

\[
\mu_0 = \frac{kg^6}{q^{4 s}} = q^{7/2}
\]

(18)

1.8. 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;

\[
f_e = \frac{c^3}{l_p}; \quad \text{units} = \frac{q^{15} s^2}{kg l^2} = 1
\]

(19)

Replacing \( q \) with the more familiar \( m \) gives this ratio;

\[
q^2 = \frac{kg m}{s}; \quad \text{units} = \frac{kg^6}{q^{4 s}}
\]

(20)

\[
\text{units} = \frac{kg^9 s^{11}}{m^{15}} = 1
\]

(21)

Electron mass as frequency of Planck mass:

\[
m_e = \frac{m_p}{f_e}, \quad \text{unit} = kg
\]

(22)

Electron wavelength via Planck length:

\[
\lambda_e = 2 \pi l_p f_e, \quad \text{unit} = \frac{q^7 s}{kg}
\]

(23)

Gravitation coupling constant:

\[
\alpha_G = \left( \frac{m_e}{m_p} \right)^2 = \frac{1}{f_e}, \quad \text{units} = 1
\]

(24)

1.9. The Rydberg constant \( R_\infty = 10973731.568508(65) \) [3] 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; \( c, \mu_0, R \) and \( \alpha \);

\[
Q^{15} = \frac{2 \pi^5 \mu_0^3}{3 \pi \alpha Q R}, \quad \text{units} = \frac{kg^{12}}{s^2} = q^{15}
\]

(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; \( R, c, \mu_0, \alpha \). I first convert the constants until they include a \( Q^{15} \) term which can then be replaced by eq(25). Setting unit \( x \) as;

\[
\text{unit} x = \frac{kg^{12}}{q^{15} s^2} = 1
\]

(26)

Elementary charge \( e = 1.602 176 51130 \times 10^{-19} \) (table p1)

\[
e = \frac{16 \pi \mu_0 c^2}{\alpha Q^3} = \frac{\pi^2 Q^5}{2 \mu_0 c^2}, \quad \text{units} = \frac{q^3 s}{kg}
\]

(27)

\[
e^3 = \frac{\pi^6 Q^{15}}{8 \mu_0 c^9} = \frac{4 \pi^3}{3 \pi \alpha Q^3 R}, \quad \text{units} = \frac{kg^3 q^3}{kg} = \left( \frac{q^3 s}{kg} \right)^3 x
\]

(28)

Planck constant \( h = 6.626 069 134 \times 10^{-34} \)

\[
h = 2 \pi Q^2 2 \pi l_p = \frac{4 \pi^4 \alpha Q^{10}}{8 \mu_0 c^5}, \quad \text{units} = \frac{q^4 s}{kg}
\]

(29)
\[ h^3 = \left( \frac{4\pi^3 a Q^0}{8\mu_0 c^5} \right)^3 \text{ units} = \left( \frac{8\pi^3 \mu_0}{36c^2 \alpha_1 R_2} \right)^3 \text{ units} = \frac{kq^2}{q^{18} s} = \left( \frac{q^4 s}{kg} \right)^{3} \cdot x^2 \]

Boltzmann constant \( k_B = 1.379 \times 10^{14} \) e-23

\[ k_B = \frac{\pi^2 a Q^0}{4c} \text{ units} = \frac{kg^3}{q} \]

Gravitation constant \( G = 6.672 \times 10^{11} \) e-11

\[ G = \frac{c^2 l_p}{m_p} = \frac{\pi a Q^0}{64\mu_0 c^2} \text{ units} = \frac{q^6 s}{kg^4} \]

Planck length

\[ l_p^{15} = \frac{\pi^2 a_0^9}{2^{35} 3^{24} c^{4} a^{3} R^{8}} \text{ units} = \frac{kg^{81}}{q^{90} s} = \left( \frac{q^{2} s}{kg} \right)^{15} \cdot x^2 \]

Electron mass \( m_e = 9.109 \times 10^{38} \times 10^{25} \) e-31

\[ m_e = \frac{16\pi^3 R_0^4}{38c^3 \alpha_1^2} \text{ units} = \frac{kg^3}{q^{40} s} = \left( \frac{q^{3} s}{kg} \right)^{5} \cdot x^2 \]

Ampere

\[ A_Q^5 = \frac{2\pi^3 c^3 \alpha_1^3 R}{\mu_0^5} \text{ units} = \frac{q^{30} s}{kg^{27}} = \left( \frac{q^{3} s}{kg} \right)^{5} \cdot \frac{1}{x} \]

1.10. \( r = \sqrt{q} \)

There is a solution for an \( r^2 = q \), it is the radiation density constant from the Stefan Boltzmann constant \( \sigma \);

\[ \sigma = \frac{2\pi^2 k^4}{15h^2 c^2} \text{ units} = \frac{4\sigma}{c} \text{ units} = r \]

\[ r^3 = \frac{3^{2} 4\pi^5 \mu_0 a^{19} R^2}{5 c^{10}} \text{ units} = \frac{kg^{30}}{q^{36} s^3} \cdot \frac{1}{x^2} = \frac{kg^6}{q^6 s} r^3 \]

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12. Boltzmann constant
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\[ \sqrt{\text{Planck momentum}} \]