On the Unification of the Constants of Nature

Brent Jarvis
Embry–Riddle Aeronautical University
JarvisB@my.erau.edu

Abstract
A short essay that unifies electromagnetism and gravity with a 5–D system of natural units.
INTRODUCTION

The magnetic flux quantum $\Phi_0$ [1, 2, 3] is equivalent to

$$\Phi_0 = \frac{h}{Q_0},$$

where $h$ is Planck's constant [4] and $Q_0$ is the charge of an alpha particle ($2e$). Planck's reduced constant $\hbar$ is

$$\hbar = \frac{h}{2\pi},$$

which can be defined further as

$$\hbar = \alpha m_e r_B c,$$

where $\alpha$ is the fine structure constant, $m_e$ is an electron's mass, $r_B$ is the Bohr radius, and $c$ is the velocity of light in a vacuum. Combining Eqs. 1, 2 and 3, the electric and magnetic flux quanta can be unified with

$$2\pi \hbar = Q_0 \Phi_0 = 2\pi \alpha m_e r_B c,$$

and since $(2\pi = Q_0 \Phi_0 / \hbar)$, Eq. 4 can be merged into

$$2\pi \hbar^2 = Q_0 \Phi_0 \alpha m_e r_B c.$$

Bohr did not deduce his radius $r_B$ from an alpha particle ($Q_0 = 2e = a$ helium nucleus and not a hydrogen nucleus). The adjusted radius $r_0$ for the helium system of natural units is defined by Eq. 5 and not by Eq. 3. The 5 dimensions of the system are balanced by the dimensionless constant $C$,

$$\frac{[2\pi] [h(eV \cdot s)] [h(kg \cdot m^2/s)]}{[Q_0(2e)] [\Phi_0(V \cdot s)] [\alpha] [m_e(kg)] [r_0(m)] [c(m/s)]} = \pi \alpha = C$$

The modified version of Eq. 5 (including $C$ and $r_0$) is

$$2Ch^2 = Q_0 \Phi_0 \alpha m_e r_0 c.$$

The total angular momentum $J$ [5] can be included with

$$2CJ^2 = n Q_0 \Phi_0 \alpha m_e r_0 c,$$

and the definition of the dimensionless unit $n = 1, 2, 3...$ is
\[ n = |\ell + s|(|\ell + s| + 1), \]

where \( \ell \) is the azimuthal quantum number and \( s \) is the spin quantum number.

**MATTER WAVES AND MASS–ENERGY**

A particle's wavelength \( \lambda \) can be determined with de Broglie's matter wave equation

\[ \lambda = \frac{\hbar}{p} = \frac{2\pi \hbar}{mv}, \]

[6] where \( p \) is the particle's momentum and \( v \) is its velocity. With the mass quantized in units of \( m_e \), Eq. 10 can be expressed in the helium natural unit system as

\[ \lambda_0 = \frac{2\pi \hbar}{m_e v_0} = \frac{n \hbar \Phi_0 \pi r_0 c}{v_0 CJ^2}, \]

where \( v_0 \) is an electron's velocity quantum. The electron's frequency quantum \( f_0 \) can be determined by

\[ f_0 = \frac{v_0}{\lambda_0} = \frac{v_0^2 CJ^2}{n \hbar \Phi_0 \pi r_0 c}. \]

The dimensionally balanced version of de Broglie's matter wave equation is

\[ n\alpha = \frac{\lambda_0 v_0 J^2}{\hbar \Phi_0 \pi r_0 c}, \]

where \( \alpha \) is the fine structure constant again. The dimensionally balanced version of Einstein's \( E = mc^2 \) is

\[ \frac{2\pi}{n\alpha} = \frac{E \Phi_0 \pi r_0}{J^2 c}, \]

and the energy of electromagnetic radiation \( (E_R = \hbar 2\pi f) \) is simply

\[ E_R = \Phi_0 \pi r_0 f_0. \]

**CONCLUSION**

Can Big-G be included in the helium unit system? Newton's gravitational constant G can be deduced from the Planck mass unit \( m_P \) [4],

\[ n = |\ell \pm s|(|\ell \pm s| + 1), \]
but a coupling factor is needed for unification since \( m_p^2 \gg m_e^2 \). To nullify the Planck mass unit, we can use the Gaussian gravitational constant \( k \) [7],

\[
(17) \quad k = \sqrt{\frac{2\pi}{T\sqrt{M + m}}},
\]

where \( T \) is a secondary’s period, \( M \) is the mass of a primary, and \( m \) is the mass of a secondary. Converting Eq. 17 into the natural units of helium we get

\[
(18) \quad k_0 = \frac{2\pi f_0}{\sqrt{M_\phi}}, \quad 2\pi = \frac{Q_0 \Phi_0}{\hbar}, \quad k_0 = \frac{Q_0 \Phi_0 f_0}{\hbar \sqrt{M_\phi}} = \frac{E_R}{\hbar \sqrt{M_\phi}}.
\]

where \( M_\phi \) is the sum of the mass of an alpha particle and \( 2m_e \). We can then include \( G \) in the units with

\[
(19) \quad G = \frac{E_R^2}{\hbar^2 M_\phi} = \frac{nE_R^2}{j^2 M_\phi}.
\]

We can see that \( G \) is directly proportional to the energy of electromagnetic radiation squared! Are black holes analogous to neutrons? By setting the mass unit to \( H = \sqrt{M_\phi} \), we can determine the standard gravitational parameter \( \mu \) of a celestial body from the angular frequency of its radiation,

\[
(20) \quad \sqrt{\mu} = Hk_0 = \frac{E_R}{\hbar} = \frac{Q_0 \Phi_0 f_0}{\hbar} = 2\pi f_0,
\]

and the frequency of gravitoelectromagnetic waves can be determined with

\[
(21) \quad f_0 = \frac{Hk_0}{2\pi}.
\]

To conclude, the relationship between gravity and electromagnetism is

\[
(22) \quad E_R \sqrt{n} = JHk_0.
\]

**DEDICATION**

This essay is dedicated to Cynthia Cashman Lett. Thank you, and I love you.
REFERENCES


