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

\[
(1) \quad \Phi_0 = \frac{h}{Q_0},
\]

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

\[
(2) \quad \hbar = \frac{h}{2\pi},
\]

which can be defined further as

\[
(3) \quad \hbar = \alpha m_e r_B c,
\]

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

\[
(4) \quad 2\pi \hbar = Q_0 \Phi_0 = 2\pi \alpha m_e r_B c,
\]

which merges into
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 is defined by Eq. 5 and not by Eq. 3. The 5 dimensions of the system are balanced by the dimensionless constant $C$,

$$2\pi \hbar^2 = Q_0 \Phi_0 e m_e r_b c.$$

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

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

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

$$2CJ^2 = nQ_0 \Phi_0 e m_e r_0 c,$$

and the definition of the dimensionless unit $n$ is

$$n = |\ell \pm s|(|\ell \pm s| + 1),$$

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 relation

$$\lambda = \frac{\hbar}{p} = \frac{2\pi \hbar}{mv}.$$

[6] where $p$ is the particle's momentum and $v$ is its velocity. With the mass quantized in units of $m_o$, Eq. 10 can be expressed in the natural units of helium as

$$\lambda = \frac{2\pi \hbar}{m_e v_0} = \frac{n\hbar Q_0 \Phi_0 \pi r_0 c}{v_0 C J^2},$$

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

$$f_0 = \frac{v_0}{\lambda_0} = \frac{v_0^2 C J^2}{n\hbar Q_0 \Phi_0 \pi r_0 c}.$$
The dimensionally balanced version of de Broglie's matter wave relation is

\[ n\alpha = \frac{-\lambda_0\nu_0r_0^2}{\hbar\Phi_0\Phi_0'r_0c}, \]

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

\[ (2\pi/n\alpha) = \frac{E_0\Phi_0r_0}{j^2c}, \]

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

\[ E_R = \Phi_0\Phi_0'f_0. \]

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],

\[ m_P = \sqrt{\frac{\hbar c}{G}}, \quad G = \frac{\hbar c}{m_P}, \]

but a coupling factor is needed for unification since \( m_P^2 >> m_e^2 \). To nullify the Planck mass unit, we can use the Gaussian gravitational constant \( k \) [7],

\[ k = \sqrt{G} = \frac{2\pi}{T\sqrt{M + m}}, \]

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 helium units we get

\[ k_0 = \frac{2\pi f_0}{\sqrt{M_0}}, \quad 2\pi = \frac{\Phi_0\Phi_0'}{\hbar}, \quad k_0 = \frac{\Phi_0\Phi_0'f_0}{\hbar\sqrt{M_0}} = \frac{E_R}{\hbar\sqrt{M_0}}. \]

where \( M_0 \) is the sum of the mass of an alpha particle and \( 2m_e \). \( G \) can then be included in the units from the relation

\[ G = \frac{E_A^2}{\hbar^2M_0} = \frac{n_eE_A^2}{j^2M_0}, \]

where \( n_e \) is relative to both electrons. We can see from Eq. 19 that \( G \) is proportional to the energy of electromagnetism squared! Are black holes analogous to neutrons?
By setting the base mass unit to $A = \sqrt{M}$, the relationship between gravity and electromagnetism can be expressed as

\[
(20) \quad E R \sqrt{n_2} = J.A k_0 !
\]

**DEDICATION**

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

**REFERENCES**

[1] "Magnetic flux quantum $\Phi_0". 2010 CODATA recommended values.