

On the Unification of the Constants of Nature

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

Abstract

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

INTRODUCTION

The magnetic flux quantum Φ_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 α 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

$$(5) \quad 2\pi\hbar^2 = Q_0\Phi_0\alpha m_e r_B c.$$

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 unit (HU) system is defined by Eq. 5 and not by Eq. 3. The 5 dimensions of the system are balanced by the dimensionless constant C,

$$(6) \frac{[2\pi] [\hbar(eV \cdot s)] [\hbar(kg \cdot m^2/s)]}{[Q_0(2e)] [\Phi_0(V \cdot s)] [\alpha] [m_e(kg)] [r_0(m)] [c(m/s)]} = \pi/\alpha = C$$

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

$$(7) 2C\hbar^2 = Q_0\Phi_0m_e r_0 c.$$

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

$$(8) 2CJ^2 = nQ_0\Phi_0m_e r_0 c,$$

and the definition of the dimensionless unit n is

$$(9) n = |\ell \pm s| (|\ell \pm s| + 1),$$

where ℓ is the azimuthal quantum number and s is the spin quantum number.

MATTER WAVES AND MASS-ENERGY

A particle's wavelength λ can be determined with de Broglie's matter wave equation

$$(10) \lambda = \frac{h}{p} = \frac{2\pi\hbar}{mv},$$

[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 with the HU system as

$$(11) \lambda_0 = \frac{2\pi\hbar}{m_e v_0} = \frac{n\hbar Q_0 \Phi_0 \pi r_0 c}{v_0 C J^2}.$$

The electron's frequency quantum f_0 can be deduced from

$$(12) f_0 = \frac{v_0}{\lambda_0} = \frac{v_0^2 C J^2}{n\hbar Q_0 \Phi_0 \pi r_0 c},$$

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

$$(13) \quad n\alpha = \frac{\lambda_0 \nu_0 J^2}{\hbar \Phi_0 Q_0 r_0 c},$$

where α is the fine structure constant again. The dimensionally balanced version of Einstein's $E = mc^2$ is

$$(14) \quad (2\pi/n\alpha) = \frac{E Q_0 \Phi_0 r_0}{J^2 c},$$

and the energy of electromagnetic radiation ($E_R = \hbar 2\pi f$) is simply the electric, magnetic, and frequency quanta,

$$(15) \quad E_R = Q_0 \Phi_0 f_0.$$

CONCLUSION

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

$$(16) \quad m_P = \sqrt{\frac{\hbar c}{G}}, \quad G = \frac{\hbar c}{m_P^2},$$

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],

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

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

$$(18) \quad k = \frac{2\pi f_0}{\sqrt{M_\phi}}, \quad 2\pi = \frac{Q_0 \Phi_0}{\hbar}, \quad k = \frac{Q_0 \Phi_0 f_0}{\hbar \sqrt{M_\phi}} = \frac{E_R}{\hbar \sqrt{M_\phi}},$$

where M_ϕ is the mass of an alpha particle $+2m_e$. We can see that the Gaussian constant is proportional to a system's energy! With the mass set to $H = \sqrt{M_\phi}$, the relationship between gravity and electromagnetism can be expressed as

$$(19) \quad H \hbar k_0 = \Phi_0 Q_0 f_0!$$

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