On the Unification of the Constants of Nature

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Abstract

A short essay that unifies electromagnetism and gravity 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 ħ 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) $2\pi\hbar^2 = Q_0\Phi_0\alpha m_e r_B c.$

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

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

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

(7) $2C\hbar^2 = Q_0\Phi_0 m_e r_0 c.$

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

(8) $2CJ^2 = nQ_0\Phi_0 m_e r_0 c,$

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 relation

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

[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 in the natural units of helium as

$$(11)\quad \lambda_0 = \frac{2\pi\hbar}{m_e v_0} = \frac{n\hbar Q_0\Phi_0\pi r_0 c}{v_0 CJ^2},$$

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

$$(12)\quad f_0 = \frac{v_0}{\lambda_0} = \frac{v_0^2 CJ^2}{n\hbar Q_0\Phi_0\pi r_0 c}.$$

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

$$(13)\quad n\alpha = \frac{\lambda_0 v_0 J^2}{\hbar \Phi_0 Q_0 r_0 c},$$

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

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

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],

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

but a coupling factor is needed for unification since $m_P^2 >> m_e^2$. 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

$$(18)\quad k_0 = \frac{2\pi f_0}{\sqrt{M_Q}},\quad 2\pi = \frac{Q_0 \Phi_0}{\hbar},\quad k_0 = \frac{Q_0 \Phi_0 f_0}{\hbar \sqrt{M_Q}} = \frac{E_R}{\hbar \sqrt{M_Q}}.$$

where M_Q is the sum of the mass of an alpha particle and $2m_e$. G can then be included in the units from the relation

$$(19)\quad G = \frac{E_R^2}{\hbar^2 M_Q} = \frac{n_2 E_R^2}{J^2 M_Q},$$

where n_2 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 $A = \sqrt{M_{\odot}}$, the relationship between gravity and electromagnetism can be expressed as

$$(20) \quad E_R\sqrt{n_2} = JAk_0!$$

DEDICATION

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

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