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

$$(1) \quad \Phi_0 = \frac{h}{♀_0},$$

where h is Planck's constant [4] and $♀_0$ 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

$$(4) \quad 2\pi\hbar = ♀_0\Phi_0 = 2\pi\alpha m_e r_B c,$$

and since ($2\pi = ♀_0\Phi_0 / \hbar$), Eq. 4 can be merged into

$$(5) \quad 2\pi\hbar^2 = ♀_0\Phi_0\alpha m_e r_B c.$$

Bohr did not deduce his radius r_B from an alpha particle ($♀_0 = 2e$ = 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,

$$(6) \quad \frac{[2\pi]\ [\hbar(\boldsymbol{eV \cdot s})]\ [\hbar(\boldsymbol{kg \cdot m^2/s})]}{[♀_0(\boldsymbol{2e})]\ [\Phi_0(\boldsymbol{V \cdot s})]\ [\alpha]\ [m_e(\boldsymbol{kg})]\ [r_0(\boldsymbol{m})]\ [c(\boldsymbol{m/s})]} = \pi/\alpha = \mathrm{C}$$

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

$$(7) \quad 2\mathrm{C}\hbar^2 = ♀_0\Phi_0 m_e r_0 c.$$

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

$$(8) \quad 2\mathrm{CJ}^2 = n♀_0\Phi_0 m_e r_0 c,$$

and the definition of the dimensionless unit n = 1, 2, 3... is

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

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

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

[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

$$(11)\quad \lambda_0 = \frac{2\pi\hbar}{\mathrm{m_e}v_0} = \frac{n\hbar\Omega_0\Phi_0\pi r_0 c}{v_0\mathrm{C}\mathrm{J}^2},$$

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

$$(12)\quad f_0 = \frac{v_0}{\lambda_0} = \frac{v_0^2\mathrm{C}\mathrm{J}^2}{n\hbar\Omega_0\Phi_0\pi r_0 c}.$$

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

$$(13)\quad n\alpha = \frac{\lambda_0 v_0 \mathrm{J}^2}{\hbar\Phi_0\Omega_0 r_0 c},$$

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

$$(14)\quad (2\pi/n\alpha) = \frac{\mathrm{E}\Omega_0\Phi_0 r_0}{\mathrm{J}^2 c},$$

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

$$(15)\quad \mathrm{E_R} = \Omega_0\Phi_0 f_0.$$

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 the natural units of helium we get

$$(18)\quad k_0 = \frac{2\pi f_0}{\sqrt{M_♀}}, \quad 2\pi = \frac{♀_0\Phi_0}{\hbar}, \quad k_0 = \frac{♀_0\Phi_0 f_0}{\hbar\sqrt{M_♀}} = \frac{E_R}{\hbar\sqrt{M_♀}}.$$

where $M_♀$ is the sum of the mass of an alpha particle and $2m_e$. We can then include G in the units with

$$(19)\quad G = \frac{E_R^2}{\hbar^2 M_♀} = \frac{nE_R^2}{J^2 M_♀}\ !$$

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 $H = \sqrt{M_♀}$ we can determine the standard gravitational parameter μ of a celestial body from the angular frequency of its radiation,

$$(20)\quad \sqrt{\mu} = Hk_0 = \frac{E_R}{\hbar} = \frac{♀_0\Phi_0 f_0}{\hbar} = 2\pi f_0,$$

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.

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