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WINNOWER

PHYSICS

On the Unification of the Constants of Nature

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A short essay that unifies gravity and electromagnetism with a system of natural units that are based upon a Helium nucleus (Alpha particle). Alternative definitions for Planck's constant and the fine structure constant are deduced and the standard gravitational parameter of a Helium nucleus is shown to be directly proportional to the square of its electromagnetic frequency.

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INTRODUCTION

The magnetic flux quantum Φ_0 is equivalent to[1], [2], [3]

$$(1) \quad \Phi_0 = \frac{h}{Z_0},$$

where h is Planck's constant[4] and Z_0 is the charge of an alpha particle (2*e*). Planck's reduced constant ħ is

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

which can also be defined with Bohr's radius r_B as

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

where *α* is the fine structure constant, m_e is the mass of a Beta particle, and *c* is the speed of light in a vacuum. Combining Eqs. (1) through (3) yields

$$(4) \quad 2\pi\hbar^2 = Z_0\Phi_0\alpha m_e r_B c, \text{ or } h = \sqrt{Z_0\Phi_0\alpha m_e 2\pi r_B c}.$$

Bohr, however, did not deduce his radius r_B from an Alpha particle ($Z_0 = 2e$ = a Helium nucleus and not a Hydrogen nucleus). The adjusted radius r_0 for a Helium atom can be deduced from Eq. (4) as $r_0 \approx 0.529177211 \times 10^{-10}$ m.

WAVE—PARTICLE DUALITY AND A NEW DEFINITION FOR THE FINE STRUCTURE CONSTANT

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

$$(5)\quad \lambda = \frac{h}{p} = \frac{2\pi\hbar}{mv},$$

where p is the particle's momentum and v is its speed[6]. With the mass quantized in units of me, a Beta particle's ground state wavelength relative to the electric and magnetic flux quanta of a Helium nucleus can be deduced from Eqs. (4) & (5) as

$$(6)\quad \lambda_0 = \frac{2\pi\hbar}{m_e v_0} = \frac{Z_0\Phi_0\alpha r_0 c}{\hbar v_0}.$$

The Beta particle's ground state frequency $f0$ is then

$$(7)\quad f_0 = \frac{v_0}{\lambda_0} = \frac{\hbar v_0^2}{Z_0\Phi_0\alpha r_0 c},$$

and a wave mechanical definition for the fine structure constant can be given as

$$(8)\quad \alpha = \frac{\hbar\lambda_0 v_0}{Z_0\Phi_0 r_0 c} = \frac{\lambda_0 v_0}{2\pi r_0 c}.$$

Eq. (8) suggests $v0 \approx \alpha c$. The energy of electromagnetic radiation (E = hf) is simply the product of the electric, magnetic, and frequency quanta;

$$(9)\quad E = Z_0\Phi_0 f_0.$$

CONCLUSION

The Gaussian gravitational constant $k0$ (not to be confused with the Coulomb constant ke)[7] is

$$(10)\quad k_0 = \sqrt{G} = \frac{2\pi}{T\sqrt{M_1+M_2}},$$

where G is Newton's gravitational constant, T is the orbital period, and M1 and M2 are the masses of the system. Setting the total mass of the system to the mass of an Alpha particle MA (MA = 2MP + 2MN where MP and MN are the proton and neutron masses), the quantized relationship between the Gaussian gravitational constant $k0$ and the electromagnetic frequency of an Alpha particle can be given as

$$(11)\quad k_0 = \frac{2\pi f_0}{\sqrt{M_A}},\quad 2\pi = \frac{Z_0\Phi_0}{\hbar},\quad k_0 = \frac{Z_0\Phi_0 f_0}{\hbar\sqrt{M_A}} = \frac{E}{\hbar\sqrt{M_A}}.$$

The standard gravitational parameter μ for the Alpha particle is therefore

$$(12)\quad GM_A = \mu = \left(\frac{E}{\hbar}\right)^2,$$

and the energy of its electromagnetic frequency is

$$(13)\quad E = \hbar\sqrt{\mu}.$$

Could Eq. (13) help explain dark energy? The nuclear frequency *fn* of an atom would then be

$$(14) \quad f_n = \frac{\sqrt{\mu n}}{2\pi},$$

where n is the nuclear mass number relative to a Helium nucleus. For Hydrogen, n = ½, Helium, n = 1, Lithium, n = 1½, Beryllium, n = 2, etcetera.

REFERENCES

[1] "Magnetic flux quantum Φ0". 2010 CODATA recommended values.

[2] Deaver, Bascom; Fairbank, William (1961). "Experimental Evidence for Quantized Flux in Superconducting Cylinders". Physical Review Letters 7 (2): 43–46.Bibcode:1961PhRvL...7...43D. doi:10.1103/PhysRevLett.7.43.

[3] Doll, R.; Näbauer, M. (1961). "Experimental Proof of Magnetic Flux Quantization in a Superconducting Ring". Physical Review Letters 7 (2): 51–52. Bibcode:1961PhRvL...7...51D.doi:10.1103/PhysRevLett.7.51.

[4] Barrow, John D. (2002) "The Constants of Nature; From Alpha to Omega – The Numbers that Encode the Deepest Secrets of the Universe", Pantheon Books, ISBN 0-375-42221-8

[5] Eisberg, Robert (1974). Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles. New York: John Wiley & Sons Inc. pp. 114–117. ISBN 978-0-471-23464-7.

[6] de Broglie, L. (1923). Waves and quanta, Nature 112: 540.

[7] Gauss, Carl Friedrich; Davis, Charles Henry (1857). Theory of the Motion of the Heavenly Bodies Moving about the Sun in Conic Sections. Little, Brown and Company, Boston., atGoogle books