INTRODUCTION

The magnetic flux quantum $\Phi_0$ [1, 2, 3] is equivalent to

$$\Phi_0 = \frac{h}{Q_0},$$

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

$$\hbar = \frac{h}{2\pi},$$

which can be defined further as

$$\hbar = \alpha m_e r_B c,$$

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. Combining Eqs. 1, 2 and 3 yields

$$2\pi \hbar^2 = Q_0 \Phi_0 \alpha m_e r_B c.$$

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 alpha particle unit system (APUS) is defined by Eq. 4. The 5 dimensions of the system are balanced by the dimensionless constant $C$,

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

The dimensionally balanced version of Eq. 4 is

$$2C = \frac{Q_0 \Phi_0 m_e r_0 c}{\hbar^2}.$$
An electron's total angular momentum \( J \) [5] can be included with

\[
(7) \quad 2C = \frac{\mathcal{D} \Phi_0 \Phi_0 m_e r_0 c}{J^2},
\]

where the definition of the dimensionless unit \( \mathcal{D} \) is

\[
(8) \quad \mathcal{D} = |l \pm s|((l \pm s) + 1),
\]

with \( l \) being an electron's azimuthal quantum number and \( s \) is its spin quantum number.

**WAVE–PARTICLE DUALITY**

A particle's wavelength \( \lambda \) can be determined with de Broglie's matter wave equation

\[
(9) \quad \lambda = \frac{\hbar}{p} = \frac{2\pi \hbar}{mv},
\]

[6] where \( p \) is the particle's momentum and \( v \) is its velocity. With the mass quantized in units of \( m_e \), the APUS expression of Eq. 9 is

\[
(10) \quad \lambda_0 = \frac{2\pi \hbar}{m_e v_0} = \frac{\mathcal{D} \Phi_0 \Phi_0 r_0 c}{v_0 J^2}.
\]

The electron's frequency quantum \( f_0 \) is

\[
(11) \quad f_0 = \frac{v_0}{\lambda_0} = \frac{v_0^2 J^2}{\mathcal{D} \Phi_0 \Phi_0 r_0 c},
\]

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

\[
(12) \quad \mathcal{D} \alpha = \frac{\lambda_0 v_0 J^2}{\hbar \Phi_0 \Phi_0 r_0 c},
\]

where \( \alpha \) is the fine structure constant again! The energy of electromagnetic radiation \( (E = \hbar c f) \) is simply the product of the electric, magnetic, and frequency quanta;

\[
(13) \quad E = \mathcal{Q}_0 \Phi_0 f_0.
\]

**CONCLUSION**

Can Big–G be included in the APUS? Newton's gravitational constant \( G \) can be deduced from the Planck mass unit \( m_P \) [4],

\[
(14) \quad m_e = \sqrt{\frac{\hbar c}{G}}, \quad G = \frac{\hbar c}{m_P^2},
\]

but a coupling factor would be needed with this definition since \( m_P^2 \gg m_e \). To avoid this, we can use the Gaussian gravitational constant \( \mathcal{K} \) [7].
where $T$ is a secondary's period, $M$ is the mass of a primary, and $m$ is the mass of a secondary.

Converting Eq. 15 into alpha units we get

\[
\frac{k}{\sqrt{M_0}} = \frac{2\pi f_0}{\sqrt{\Omega}}, \quad \frac{2\pi}{\hbar} = \frac{Q_0\Phi_0}{\hbar\sqrt{M_0}}, \quad \frac{k}{\sqrt{M_0}} = \frac{E}{\hbar\sqrt{M_0}},
\]

where $M_0$ is the mass of an alpha particle +2me (helium). We can see that the Gaussian gravitational constant $k$ is proportional to a system's energy! The quantum mechanical relationship between gravity and electromagnetism can therefore be given as

\[
k_0(E, \sqrt{nM_0}) = \frac{Q_0\Phi_0}{\hbar\sqrt{nM_0}},
\]

where $n$ is an atomic system's mass number relative to helium. For lithium, $n = 1.5$, for beryllium, $n = 2$, for boron $n = 2.5$, etc.

REFERENCES

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


