Electrifying Gravity

A Theory of Everything should be intelligible to everyone otherwise the universe would be undemocratic. In this paper, I equate gravity with the electrostatic force in a way that can be understood by anyone with basic mathematical skills and with some patience in statistical analysis. I derive the gravitational constant from the electrostatic force in relation to the masses of the electron and proton. I argue that gravity and the electrostatic force are of different strengths only in so far as they operate in different Compton times. I equate the two forces in terms of a form of Planck mass which is associated with the fine structure constant and which has a unique affinity with the electron and the proton. I have selected statistics that support my argument but some statistics are intended to stimulate further enquiry. Those who follow the trail are pioneers.

A. Some definitions

A1. I shall refer to three kinds of wavelengths:

a) de Broglie wavelengths c^2/vf or h/mv
b) Compton wavelengths c/f or h/mc
c) Ordinary wavelengths v/f or vh/mc^2

In each case, v is the speed of a mass, f is its Compton frequency(1), h is Planck's constant(2) and c is the speed of light(3). De Broglie wavelengths are considered here as pilot waves travelling at speeds faster than light. The three wavelengths are symmetrical such that, if a de Broglie wavelength is twice as long as a Compton wavelength, the Ordinary wavelength is half a Compton wavelength.

An example of an Ordinary wavelength is the electron itself. Its 'classical' radius(4) is usually calculated from the relation $r_e = Ke^2/m_e c^2$, where K is Coulomb's constant(5), e^2 is the square of the elementary charge(6) and m_e is the mass of the electron(7). The radius however is also equal to $v/2\pi f_e$, where v is the electron's speed in the first orbit of a hydrogen atom ($c/137.036$) and f_e is the electron's Compton frequency(8).

A2. I derive a precise form of the gravitational constant from the ratio $Ke^2/GM_p m_e$, where G is the gravitational constant(9) and M_p is the mass of the proton(10). The ratio is approximately equal to $F_p \times 10^{16}$ where F_p is the proton's Compton frequency(11) here converted to a much larger, dimensionless quantity. Assuming true equality then $G = Ke^2 / M_p m_e F_p \times 10^{16} = 6.67409 \times 10^{-11} m^3 Kg^{-1} s^{-2}$.
Substituting the above ratio for G, gravitational force can be expressed in the form $(Ke^2 / M_p m_e F_p \times 10^{16}) \times (Mm/r^2)$. For the electron and proton, mass cancels out, yielding the equation $Ke^2/r^2 F_p \times 10^{16}$.

B. Equating the forces in time

B1. Energy is inversely proportional to time ($E = hf$). If therefore gravity and the electrostatic force are the same force at different strengths, we might assume that th ey operate in different Compton times. They can therefore be equated by locating them in the same time, which for convenience can be one second. This argument is most clearly understood in terms of the first orbit of a hydrogen atom, which is simply the electron's de Broglie wavelength: $r_0 = c^2 / v f_e 2\pi$ where r_0 is the Bohr radius[12] and $v = c/137.036$. If the speed of the pilot wave is measured in a one second period the radius balloons out to $c^2/v2\pi$. The constant Ke^2 can also be converted to a one second period because it is the product of the electron's energy and its 'classical' radius, both of which belong to periods much smaller than one second: $Ke^2 = m_e c^2 r_e$ where $m_e c^2 = h f_e$ and $r_e = v/ f_e 2\pi$. Converted to a one second period, the electron's energy reduces to h (because $f = 1$ and therefore $hf = h$) while the 'classical' radius balloons to $v/2\pi$. Thus $Ke^2 = hv/2\pi$ where the reduction in energy is matched by the increase in radius.

Putting all these one second conversions together, the electrostatic force ($Ke^2/{r_0}^2 = 8.2387\times10^{-8}\, N.m^2.C^2$) becomes

$$\frac{hv/2\pi}{\left(c^2/v2\pi\right)^2} = \frac{hv^3 2\pi}{c^4} = 5.3965\times10^{-48}\, N.m^2.C^2 .$$

Expressed in these terms the electrostatic force shrinks to a degree that merits a special name for it – let's call it the Wee force. Orbits greater than the first orbit, or distances greater than r_0, comprise multiples of de Broglie wavelengths and for these we need to factor into the Wee formula the principal quantum number $n = \sqrt{r/r_0}$ where r is any distance. The Wee Force then becomes:

$$\frac{hv^3 2\pi}{c^4 n} \text{ where } v = c/137.036n .$$

The electrostatic force exceeds the Wee force by the factor ${f_e}^2$ and the Wee force therefore is more conveniently expressed as $\dfrac{Ke^2}{r^2 {f_e}^2}$.

B2. Since the imaginary Wee force operates in a one second period, the period of the electrostatic force is $1/ {f_e}^2$. For the electron-proton combination, the electrostatic force exceeds gravity by the factor $F_p \times 10^{16}$ and therefore the period for gravity for these two bodies is $F_p \times 10^{16} / {f_e}^2 = 0.1486$ seconds.

Using the relation $v_G = \sqrt{GM_p / r_0}$, where v_G is the electron's gravity speed, we can calculate that a first orbit electron, governed by gravity alone, would travel at $4.593\times10^{-14}\, m.s.$ At that speed it would complete the first orbit ($2\pi r_0$) in 7239 seconds, which is equal to $137.036^2 \times \sqrt{0.1486}$ seconds. Since an electron actually completes the first orbit in the time $137.036^2 \times 1/ f_e$ seconds, we might assume that $\sqrt{0.1486}$ is a dilated version of the electron's Compton time $1/ f_e$. This assumption is supported by the fact that the Ordinary wavelength (v/f) is the same for both gravity and the electrostatic force: $4.593\times10^{-14}\,m.s.\times\sqrt{0.1486}=(c/137.036)\times1/f_e=2\pi r_e$.

The time 0.1486 seconds exceeds the electron's Compton time by the factor $(F_p/f_e)\times10^{16}$. The time $\sqrt{0.1486}$ seconds exceeds the electron's Compton time by the factor $\sqrt{(F_p\times10^{16})}$. In general terms, the time it takes an electron at gravity speed to complete any orbit n may be calculated from the electrostatic speed using the formula $(c/v_E)^2\times n\sqrt{0.1486}$, where v_E is the electron's electrostatic speed. The electron's gravity speed can be calculated from its electrostatic speed using the formula $v_G=(v_E/f_e)\times(1/\sqrt{0.1486})$.

Multiplied by their own periods, gravity and the electrostatic force always equal the Wee force: $\left(\frac{Ke^2}{r^2F_p\times10^{16}}\right)\times\left(\frac{F_p\times10^{16}}{f_e^{\,2}}\right)=\left(\frac{Ke^2}{r^2}\right)\times\left(\frac{1}{f_e^{\,2}}\right)=\frac{Ke^2}{r^2f_e^{\,2}}$

B3. Assuming that gravity, the electrostatic force and the Wee force are all the same force operating in different periods, everything might be said to have a Wee speed and an electrostatic speed which can be calculated in the same manner as for gravity by the relation $v=\sqrt{F_{orce}\times r/m}$, where v is the speed of any mass m and where r is the distance between m and some other mass. With respect to the Wee force, the formula presents us with a dilemma because we've already equated r with the distance travelled by the electron's pilot wave in one second such that $r=c^2/v2\pi=\frac{c137.036\sqrt{r}}{2\pi\sqrt{r_0}}$. Yet the Wee force is also expressed as $Ke^2/r^2\,f_e^{\,2}$ in which case r is the smaller, conventional distance. It is this conventional form of r that I use in the formula $v=\sqrt{F_{orce}\times r/m}$. According to this usage, the electron's gravity speed exceeds its Wee speed by the factor $1/\sqrt{0.1486}$. In that case, the electron's Wee speeds are simply its Ordinary wavelengths v_E/f_e where v_E is its electrostatic speed.

B4. The Wee force can be related to gravity in the form:

$$\frac{Gyz}{r^2}=\frac{Ke^2}{r^2f_e^{\,2}}\times\frac{yz}{M_pm_e0.1486}$$

The right hand factor may be called the 'equivalence factor' since it sets the Wee force equal to gravity (it is the gravity period represented in this case as a frequency). If y and z are the electron and proton, the equivalence factor is simply 1/0.1486. Unlike gravity, which varies with changes in mass and distance, the Wee force and the electrostatic force vary only with changes in distance (Ke^2 is constant). Since the force is unaffected by changes in mass then, according to the formula $v=\sqrt{F_{orce}\times r/m}$, the Wee speed of any mass y is simply calculated in the form $\sqrt{Ke^2/rf_e^{\,2}y}$ which is the same as dividing the electron's Wee speed by $\sqrt{y/m_e}$. In that case the Wee speed of y , when multiplied by the square root of the equivalence factor, equals the gravity speed of y . The same is true for z .

B5. To compare gravity with the electrostatic force, we must remove $f_e^{\,2}$ from the Wee force and put it in the equivalence factor. Since $f_e^{\,2}0.1486 = F_p \times 10^{16}$ gravity and the electrostatic force are related in the form:

$$\frac{Gyz}{r^2} = \frac{Ke^2}{r^2} \times \frac{yz}{M_p m_e F \times 10^{16}}$$

The electrostatic speed of any mass y is calculated as $\sqrt{Ke^2/ry}$ which is the same as dividing the electron's electrostatic speed by $\sqrt{y/m_e}$. The square root of the equivalence factor shown here is the factor by which electrostatic speeds are equated with gravity speeds.

The Electrostatic force and the Wee force operate in specific period s, $1/f_e^{\,2}$ and 1 second respectively, whereas gravity operates in an infinite variety of periods determined by different combinations of mass, and yet the different speeds associated with each force are all *apparently* measured in a 1 second period.

I am indebted to James Gilson for the advice that led to the following scenario: For the first orbit of a hydrogen atom, the Wee potential energy as given by $Ke^2/(c^2/v2\pi)$ *exceeds by the factor* $(M_p/m_e)\times 10^{16}$ *the gravitational energy* $GM_p m_e/r_0$ *. On the other hand, the kinetic potential energy* Ke^2/r_0 *exceeds Wee potential energy by the factor* f_e *. This looks to be the most meaningful way of relating the forces in so far as the ratios a re familiar quantities. I have not yet investigated the possibility of adapting the equivalence factor to potential energy.*

<u>C. Equating the forces in terms of mass</u>

C1. When gravity and the electrostatic force operate in the same period the equivalence factor is 1 and therefore $\frac{Gm_1m_2}{r^2} = \frac{Ke^2}{r^2}$ such that $m_1m_2 = \frac{Ke^2}{G}$. If m_1m_2 is interpreted as the square of a single mass A then $A = \sqrt{Ke^2/G}$ which is equal to $\sqrt{hc/2\pi G137.036}$, a unique form of Planck mass equal to $1.859238\times 10^{-9}\,Kg$. This is quite an amazing mass. Let's call it the A-mass (or let's name it after me the 'nRomhsPcsroenMs-mass').

If we imagine the A-mass to be in the first orbit of a hydrogen atom, its electrostatic speed would be $v_E = \sqrt{Ke^2/r_0A} = 4.8424\times 10^{-5}\,m.s.$ If we imagine a body to be in gravitational orbit around the A-mass, with r_0 the radius of the orbit, the gravitational speed would be $v_G = \sqrt{GA/r_0} = 4.8424 \times 10^{-5} m.s.$

If we insert the A-mass into the equivalence factor for the Wee Force $\dfrac{yz}{M_p m_e 0.1486}$,where yz in this case is A^2, the factor equals $f_e^{\,2}$. If we insert the A-mass into the equivalence factor for the electrostatic force $\dfrac{yz}{M_p m_e F_p \times 10^{16}}$ the factor is equal to 1. In other words $A^2 = M_p m_e F_p \times 10^{16}$. Gravity and the electrostatic force can therefore be equated in the form: $\dfrac{Gyz}{r^2} = \dfrac{Ke^2}{r^2} \times \dfrac{yz}{A^2}$

C2. The A-mass has many amazing properties. If we suppose that every mass has its own 'classical' radius as defined by Ke^2/mc^2 the 'classical' radius of the A-mass is equal to its gravitational radius GA/c^2 . Moreover this radius multiplied by $2\pi 137.036$ is equal to the Compton wavelength for the A-mass. These relationships, in a mutated form, are true of any two masses yz in so far as $yz = A^2$. Thus if the electron is y its monstrous partner z would be 3.79473×10^{12} Kg. Multiplied together they equal A^2 and they share the properties of the A-mass albeit in a monstrous form – the Compton wavelength of either the electron or the monstrous z-mass exceeds the other's gravitational radius by the factor $2\pi 137.036$ and its own gravitational radius is equal to the other's 'classical' radius. These might be dismissed as freaks of nature but it is in some such form that the electron and proton are coupled together. The union in this case is mediated by the relation $A^2/M_p m_e = F_p \times 10^{16}$ such that either's Compton wavelength exceeds the other's gravitational radius by the factor $2\pi 137.036 F_p \times 10^{16}$. Similarly $F_p \times 10^{16}$ is the factor separating either's 'classical' radius from the other's gravitational radius.

As indicated by the relation $A = \sqrt{M_p m_e F_p \times 10^{16}}$ the A-mass appears to have a unique affinity with the electron-proton combination. Thus $A^2/m_e^{\,2} = F_p f_e 0.1486$ while $A^2/M_p^{\,2} = f_e \times 10^{16}$. If we equate the Ordinary wavelength of the A-mass with its own gravitational 'wavelength' ($v/f_A = 2\pi GA/c^2$) then $v = c/137.036$, which is also the electron's first orbit speed. The de Broglie wavelength for the A-mass travelling at $c/137.036$ is 1.629×10^{-31} m. Suppose then that this is an orbit, the radius for which is 2.5927×10^{-32} m. If we then imagine a body to be in gravitational orbit around the electron where $r = 2.5927 \times 10^{-32}$ m, then $\sqrt{Gm_e/r} = \sqrt{GA/r_0}$.

C3. The speed $c/137.036$ is intimately connected with the constant Ke^2 because (as shown in section B1) $Ke^2 = m_e c^2 r_e = vh/2\pi$ where $v = c/137.036$. Any mass y can be imagined to have a 'classical' radius (as defined by $c/2\pi 137.036 f_y$ or Ke^2/yc^2)

and its 'classical' radius r_y is related to its gravitational radius r_{gy} in the form $r_y / r_{gy} = A^2 / y^2$. For the A-mass of course the ratio equals 1. For the proton, the ratio is equal to $f_e \times 10^{16}$ and for the electron $F_p f_e 0.1486$.

Owing to its unique association with the A-mass, the speed $c/137.036$ is fundamental to the union of gravity with the electrostatic force and it is no co-incidence that the electron happens to orbit the proton at just that speed. Moreover, just as there is a dynamic symmetry between a body's de Broglie wavelength and its Ordinary wavelength as determined by the body's speed relative to light, so there is a static symmetry between its gravitational and 'classical' radius as determined by its mass relative to the A-mass. There might in fact be some profound link between these two sets of symmetries, perhaps in terms of momentum.

C4. Suppose that some mass X is in gravitational orbit around an identical mass X , then set the equivalence factor for the Wee force equal to the Compton frequency for X , such that $\frac{X^2}{M_p m_e 0.1486} = \frac{Xc^2}{h}$, then $X = \frac{M_p m_e 0.1486 c^2}{h} = 3.0711854 \times 10^{-8}$ Kg. The Compton frequency for X equals A^2 / m_e^2 and therefore the equivalence factor also equals A^2 / m_e^2 . If the square root of the equivalence factor is the Compton frequency of another mass A_W then $\frac{A}{m_e} = \frac{A_W c^2}{h}$ and therefore $\frac{A}{A_W} = \frac{m_e c^2}{h} = f_e$. In that case $A_W = 1.504737 \times 10^{-29} Kg = \sqrt{M_p m_e 0.1486}$. Gravity can then be equated with the Wee force in the form $\frac{Gyz}{r^2} = \frac{Ke^2}{r^2 f_e^2} \times \frac{yz}{A_W^2}$.

A_W is clearly the Wee force version of the A-mass ($A_W = A / f_e$) and its mass ratio with the electron and proton deserves some analysis: $A_W^2 / M_p^2 = 1 \times 10^{16} / f_e$ and $A_W^2 / m_e^2 = F_p 0.1486 / f_e$. The product of these two ratios:

$$\frac{A_W^2}{M_p^2} \times \frac{A_W^2}{m_e^2} = \frac{F_p \times 10^{16} \times 0.1486}{f_e^2} = 0.1486^2$$

The product of the A-mass ratios: $\frac{A^2}{M_p^2} \times \frac{A^2}{m_e^2} = f_e^2 F_p 0.1486 = \left(F_p x 10^{16}\right)^2$

D. Conclusion:

The electrostatic force appears closely associated with gravity when we equate the gravitational constant with $\frac{Ke^2}{M_p m_e F_p \times 10^{16}}$. If we interpret the electrostatic force as the electron's energy multiplied by the ratio of its ordinary speed to its pilot wave speed (r_e / r_0), and when we measure its energy and speeds in a one second period, the electrostatic force then diminishes to near equality with gravity, as expressed by the ratio $M_p m_e / A_W{}^2$, which can be interpreted as a frequency relative to one second. If this analysis is sound then any combination of masses can be assigned its own gravitational frequency or period, from which it would appear that the electrostatic force is a specific form of gravity.

In this paper, I have made daring use of conjecture supported by naïve maths because (perhaps I should have admitted this right at the very start) I have little knowledge of maths and even less of physics. If however I have arrived at some useful conclusions, the main conclusion must be that much can be achieved with little and that a Theory of Everything might therefore be within reach of ordinary minds and abilities. *E pluribus unum* – a democratic universe in our time.

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Footnotes

The values quoted here, with the exception of frequencies and Coulomb's constant, are quoted from the NIST website, posted 2002.

1. Compton frequencies are equal to mc^2/h
2. h (Planck's constant) $6.6260693 \times 10^{-34}\, J.s.$
3. c (speed of light) $2.99792458 \times 10^{8}\, m/s$
4. r_e (classical radius) $2.81794 \times 10^{-15}\, m$
5. K (Coulomb's Constant) $8.9876 \times 10^{9}\, N.m^2.C^{-2}$
6. e (elementary charge) $1.602176 \times 10^{-19}\, C$
7. m_e (mass of electron) $9.1093826 \times 10^{-31}\, Kg$
8. f_e (electron's Compton frequency) $1.23559 \times 10^{20}\, Hz$
9. G (gravitational constant) $6.6742 \times 10^{-11}\, m^3 Kg^{-1} s^{-2}$ (In this paper, calculated to be $6.67409 \times 10^{-11}\, m^3 Kg^{-1} s^{-2}$)
10. M_p (mass of proton) $1.67262171 \times 10^{-27}\, Kg$
11. F_p (proton's Compton frequency) $2.268732 \times 10^{23}\, Hz$
12. r_0 (Bohr radius) $0.5291772 \times 10^{-10}\, m$