Unification of Gravity and Electromagnetism
GravityElectroMagnetism
A Probability Interpretation of Gravity

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Abstract

In this paper I will first show that Coulomb's electrostatic force formula is mathematically exactly the same as Newton's universal gravitational force at the very bottom of the rabbit hole — that is for two Planck masses. Still, the electrostatic force is much stronger than the gravity force when we are working with any non-Planck masses. We show that the difference in strength between the gravity and the electromagnetism is likely due to the fact that electromagnetism can be seen as aligned matter ("superimposed" gravity), and standard gravity is related to non-aligned matter (waves). Mathematically the difference between gravity and electromagnetism is simply linked to a joint probability factor; this is probably one for aligned matter (electromagnetism) and is close to zero for gravity. Actually, the dimensionless gravitational coupling constant is directly related to this gravitational probability factor. Based on this new view, we claim to have unified electromagnetism and gravity. This paper could have major implications for our entire view on physics from the largest to the smallest scales. For example, we show that electron voltage and ionization can basically be calculated from the Newtonian gravitational escape velocity when it is adjusted to take aligned matter (electromagnetism) into account. Up until now, we have had electromagnetism and gravity; from now on there is GravityElectroMagnetism!

Key words: Newton's gravitational force, unification, gravitational probability, dimensionless gravitational coupling constant, Coulomb's force, Coulomb's constant, Planck units, quantum realm, Planck mass, fine structure constant, escape velocity, electron voltage, ionization energy.

1 A New Perspective on the Planck Units

Haug (2016a,c) suggests that the gravitational constant should be written as a function of Planck's reduced constant[1]

$$G_p = \frac{l_p^2 c^3}{\hbar} \tag{1}$$

This way of writing Newton's gravitational constant does not change the value of the constant. If one knows the Planck length, then the gravitational constant is known, or alternatively and more practically one can calibrate the Planck length based on empirical measurements of the gravitational constant. Based on this, the Planck length is given by

$$l_p = \sqrt{\frac{\hbar G_p}{c^3}} = \sqrt{\frac{\hbar \frac{l_p^2 c^3}{\hbar}}{c^3}} = l_p \tag{2}$$

Next the Planck mass in this context results in

*e-mail espenhaug@mac.com. Thanks to Victoria Terces for helping me edit this manuscript. The difference between version 3 and 4 is basically just a few typos in the derivations of equation 18 that got fixed, the end result is still the same. Comments are welcome.

[1]Here we use a notation more familiar to modern physics.

$$m_p = \sqrt{\frac{\hbar c}{G_p}} = \sqrt{\frac{\hbar c}{\frac{l_p^2 c^3}{\hbar}}} = \frac{\hbar}{l_p}\frac{1}{c} \tag{3}$$

Based on the quantized gravitational constant, the Planck energy can be simplified to

$$E_p = m_p c^2 = \sqrt{\frac{\hbar c}{G_p}} c^2 = \frac{\hbar}{l_p}\frac{1}{c}c^2 = \frac{\hbar}{l_p}c \tag{4}$$

Table 1 summarizes of all of the Planck units given by Haug (2016a) written in a simplified form[2]. This way of writing the Planck units does not change the value of the Planck units; it merely makes it much simpler to interpret the Planck units and their similarities and differences and to gain some deeper intuition. One interesting thing to note from the table is that in the Planck form of the Planck units, one has $c^{1.5}$, $c^{2.5}$, $c^{3.5}$ and $c^{4.5}$ as well as c^4, c^5, c^7, c^8 and it is very hard to find any intuition in c powered to such numbers. In the rewritten forms introduced in this paper, we only have c in most of the units, and c^2 for just the Planck power and Planck intensity. The rewritten forms are much easier to work with mathematically and make it easier to see relationships that have not been discussed much before. Here we will look into one such relationship, namely the potential relationship between Coulomb's electrostatic force and Newton's gravitational force, and we will discover how electromagnetism can actually be seen as aligned matter.

Table 1: The table shows the standard Planck units and the units rewritten in a simpler and more intuitive form.

Units:	**"Normal"-form:**	**Simplified-form:**
Gravitational constant	$G \approx 6.67408 \times 10^{-11}$	$G_p = \frac{l_p^2 c^3}{\hbar}$
Planck length	$l_p = \sqrt{\frac{\hbar G_p}{c^3}}$	$l_p = l_p$
Planck time	$t_p = \sqrt{\frac{\hbar G_p}{c^5}}$	$t_p = \frac{l_p}{c}$
Planck mass	$m_p = \sqrt{\frac{\hbar c}{G_p}}$	$m_p = \frac{\hbar}{l_p}\frac{1}{c}$
Planck energy	$E_p = \sqrt{\frac{\hbar c^5}{G_p}}$	$E_p = \frac{\hbar}{l_p}c$
Relationship mass and energy	$E_p = m_p c^2$	$\frac{\hbar}{l_p}c = \frac{\hbar}{l_p}\frac{1}{c}c^2$
Reduced Compton wavelength	$\bar{\lambda}_p = \frac{\hbar}{m_p c}$	$\bar{\lambda}_p = l_p$
Planck area	$l_p^2 = \frac{\hbar G_p}{c^3}$	$l_p^2 = l_p^2$
Planck volume	$l_p^3 = \sqrt{\frac{\hbar^3 G_p^3}{c^9}}$	$l_p^3 = l_p^3$
Planck force	$F_p = \frac{c^4}{G_p}$	$F_p = \frac{\hbar}{l_p}\frac{c}{l_p}$
Planck power	$P_p = \frac{c^5}{G_p}$	$P_p = \frac{\hbar}{l_p}\frac{c^2}{l_p}$
Planck mass density	$\rho_p = \frac{c^5}{\hbar G_p^2}$	$\rho_p = \frac{\hbar}{l_p}\frac{1}{c l_p^3}$
Planck energy density	$\rho_p^E = \frac{c^7}{\hbar G_p^2}$	$\rho_p^E = \frac{\hbar}{l_p}\frac{c}{l_p^3}$
Planck intensity	$I_p = \frac{c^8}{\hbar G^2}$	$I_p = \frac{\hbar}{l_p}\frac{c^2}{l_p^3}$
Planck frequency	$\omega_p = \sqrt{\frac{c^5}{\hbar G}}$	$\omega_p = \frac{c}{l_p}$
Planck pressure	$p_p = \frac{c^7}{\hbar G^2}$	$p_p = \frac{\hbar}{l_p}\frac{c}{l_p^3}$
Coulomb's constant	$k_e = c^2 \times 10^{-7} \approx 8.99 \times 10^9$	$k_e = c^2 \times 10^{-7}$
Planck charge	$q_p = \sqrt{4\pi\epsilon_0 \hbar c} = \frac{e}{\sqrt{\alpha}}$	$q_p = \sqrt{\frac{\hbar}{c}}\sqrt{10^7}$
Planck current	$I_p = \sqrt{\frac{4\pi\epsilon_0 c^6}{G}}$	$I_p = \frac{c}{l_p}\sqrt{\frac{\hbar}{c}}\sqrt{10^7}$
Planck voltage	$V_p = \sqrt{\frac{c^4}{4\pi\epsilon_0 G}}$	$V_p = \frac{c}{l_p}\sqrt{c\hbar}\sqrt{10^{-7}}$
Planck impedance	$Z_p = \frac{1}{4\pi\epsilon_0 c}$	$Z_p = c \times 10^{-7}$
Electric energy	$E_p = q_p V_p = \sqrt{\frac{\hbar c^5}{G_p}}$	$E_p = q_p V_p = \frac{\hbar}{l_p}c$

[2]Here we have extended the list to include Planck units linked to electromagnetism as well.

2 The Same Force?

In 1686, Isaac Newton published his law of the gravitational force, given by

$$F_G = G\frac{m_1 m_2}{r^2} \tag{5}$$

where $G \approx 6.674 \times 10^{-11}$ is Newton's gravitational constant and m_1 and m_2 are two masses, and r is the distance between the centers of the masses. In 1784, almost hundred years after Newton published the gravitational force formula, Charles Augustin de Coulomb described the force interacting between electrostatically charged particles as

$$F_C = k_e\frac{q_1 q_2}{r^2} \tag{6}$$

where $k_e = c^2 \times 10^{-7} \approx 8.99 \times 10^9$ is Coulomb's constant and q_1 and q_2 are the two charges and r is the distance between the center of the masses. Coulomb's force and Newton's gravitational force look remarkably similar from a purely functional form. They both follow the so-called inverse square law, but they are considered to be two different forces by modern physics. The Coulomb constant k_e and the Newton gravitational constant G have very different values, where Coulomb's formula require charges as inputs and Newtons formula requires masses. However, when we first rewrite the formulas in the quantized forms based on the Planck units given in Table 1, we can see that they are exactly the same force, at least mathematically. Newton's law of gravitation can be rewritten as

$$\begin{aligned} F_G &= G_p\frac{m_1 m_2}{r^2} \\ F_G &= G_p\frac{N_1 m_p N_2 m_p}{r^2} \\ F_G &= G_p\frac{N_1 \frac{\hbar}{l_p}\frac{1}{c} N_2 \frac{\hbar}{l_p}\frac{1}{c}}{r^2} \\ F_G &= \frac{l_p^2 c^3}{\hbar}\frac{N_1 \frac{\hbar}{l_p}\frac{1}{c} N_2 \frac{\hbar}{l_p}\frac{1}{c}}{r^2} \\ F_G &= N_1 N_2 \frac{\hbar c}{r^2} \end{aligned} \tag{7}$$

where N_1 and N_2 are the numbers of Planck masses in mass one and mass two respectively. In the special case when we simply have two Planck masses and where $r = l_p$, we simply get

$$F_G = \frac{\hbar}{l_p}\frac{c}{l_p} \tag{8}$$

Coulomb's law rewritten in Planck form is given by

$$\begin{aligned} F_C &= k_e\frac{q_1 q_2}{r^2} \\ F_C &= k_e\frac{N_1 q_p N_2 q_p}{r^2} \\ F_C &= c^2 \times 10^{-7}\frac{N_1\sqrt{\frac{\hbar}{c}}\sqrt{10^7} N_2\sqrt{\frac{\hbar}{c}}\sqrt{10^7}}{r^2} \\ F_C &= N_1 N_2 \frac{\hbar c}{r^2} \end{aligned} \tag{9}$$

From the derivations above, it seems that the Newton and Coulomb constants, G and k_e, have no deeper meaning for two Planck masses other than to manipulate their input into the correct formula for the same force. We could just as well have come up with another formula based on the total rest mass energy of the objects in question, for example, and then introduced yet another constant to turn these two rest mass energies into the gravitational force. This is no surprise, as the insights into the quantum realm and the relationship between energy and matter were much more limited back in Newton and Coulomb's time. Naturally we also have

$$\frac{F_C}{F_G} = \frac{k_e \frac{N_1 q_p N_2 q_p}{r^2}}{G_p \frac{N_1 m_p N_2 m_p}{r^2}}$$
$$\frac{F_C}{F_G} = \frac{k_e N_1 q_p N_2 q_p}{G_p N_1 m_p N_2 m_p}$$
$$\frac{F_C}{F_G} = \frac{N_1 N_2 \frac{\hbar c}{r^2}}{N_1 N_2 \frac{\hbar c}{r^2}} = 1 \quad (10)$$

That is to say the gravitational force and the Coulomb's electrostatic force are ultimately the same formula at the Planck scale and they naturally also have the same strength, but that only holds true when we have two Planck masses, not for any other non-Planck mass.

3 Why Is Gravity So Weak Compared to Electromagnetism?

Gravity, as understood by modern physics, is very weak compared to the electrostatic force, and we do not dispute this. Like many others, we have asked the question why, and we think that by a lucky stroke of serendipity we have solved it.[3] This view is based on modern physics formulas that are true for any non-Planck masses. For example, let's look at the strength of gravity compared to Coulomb's electrostatic force for two electrons; it is given by

$$\frac{F_G}{F_C} = \frac{G m_e m_e}{k_e e e}$$
$$\frac{F_G}{F_C} = \frac{\frac{l_p^2 c^3}{\hbar} \frac{\hbar}{\bar{\lambda}_e} \frac{1}{c} \frac{\hbar}{\bar{\lambda}_e} \frac{1}{c}}{c^2 \times 10^{-7} \sqrt{\frac{\hbar}{c}} \sqrt{\alpha} \sqrt{10^7} \sqrt{\frac{\hbar}{c}} \sqrt{\alpha} \sqrt{10^7}}$$
$$\frac{F_G}{F_C} = \frac{\frac{l_p^2 c}{\hbar} \frac{\hbar}{\bar{\lambda}_e} \frac{\hbar}{\bar{\lambda}_e}}{\hbar c \alpha}$$
$$\frac{F_G}{F_C} = \frac{\frac{l_p^2}{\bar{\lambda}_e^2} \hbar c}{\hbar c \alpha}$$
$$\frac{F_G}{F_C} = \frac{l_p^2}{\bar{\lambda}_e^2 \alpha} \quad (11)$$

This is an extremely interesting result. If we ignore the fine structure constant for a second, we see that gravity is equal to the electrostatic force multiplied by $\frac{l_p^2}{\bar{\lambda}_e^2}$. This factor, we will claim, should be interpreted as a probability of gravitational hits (inference). As we soon will see, it likely a joint probability, which is related to two masses. In particles where the matter "waves" not are aligned, this probability will be equal to this factor. For aligned matter the probability is, on the other hand, equal to one. Electromagnetism and gravity are likely the same single mechanism (force) at the depth of reality. This is something similar to inference patterns of light. Two superimposed laser beams behave very differently than normal light, because when they are superimposed and same wavelength they give an inference pattern. We claim that something similar happens with matter; matter can be superimposed with other matter and this is the same as gravity, but now much stronger.

Above we looked at two identical masses, specifically two electron size masses. What if we compare the gravity and charge forces between an electron and a proton? Then we will get

[3] But remember Einstein said "God does not throw Dice" and Einstein was a very smart man indeed.

$$
\begin{aligned}
\frac{F_G}{F_C} &= \frac{G m_{proton} m_e}{k_e e e} \\
\frac{F_G}{F_C} &= \frac{\frac{l_p^2 c^3}{\hbar}\frac{\hbar}{\bar{\lambda}_p}\frac{1}{c}\frac{\hbar}{\bar{\lambda}_e}\frac{1}{c}}{c^2 \times 10^{-7}\sqrt{\frac{\hbar}{c}}\sqrt{\alpha}\sqrt{10^7}\sqrt{\frac{\hbar}{c}}\sqrt{\alpha}\sqrt{10^7}} \\
\frac{F_G}{F_C} &= \frac{\frac{l_p^2 c}{\hbar}\frac{\hbar}{\bar{\lambda}_p}\frac{\hbar}{\bar{\lambda}_e}}{\hbar c} \\
\frac{F_G}{F_C} &= \frac{\frac{l_p^2}{\bar{\lambda}_p\bar{\lambda}_e}\hbar c}{\hbar c \alpha} \\
\frac{F_G}{F_C} &= \frac{l_p^2}{\bar{\lambda}_e\bar{\lambda}_p\alpha}
\end{aligned}
\qquad (12)
$$

where $\bar{\lambda}_p$ is the reduced Compton wavelength of a proton. The difference between the charge force and the gravity force is now $\frac{l_p^2}{\bar{\lambda}_e\bar{\lambda}_p\alpha}$. Again, if we ignore the fine structure constant for a second, we see that gravity is equal to the electrostatic force multiplied by $\frac{l_p^2}{\bar{\lambda}_e\bar{\lambda}_p}$. We suggest this should be interpreted as a joint probability. Think of a very fundamental "particle" with diameter l_p moving around (back and forth?) over a length $\bar{\lambda}_e$ in the electron and another similar fundamental particle moving inside (back and forth?) over a distance $\bar{\lambda}_p$ in the proton. Assume a graviton with diameter $\leq l_p$ is transversely moving towards $\bar{\lambda}_p$. What is the probability the "graviton" (conditional that it passes inside the length interval $\bar{\lambda}$) will hit the fundamental particle with diameter l_p that is at a unknown position inside the length interval $\bar{\lambda}_p$, it must be $\frac{l_p}{\bar{\lambda}_p}$. Further assume a graviton is transversely passing the length $\bar{\lambda}_e$. What is the probability it will "hit" the fundamental particle with diameter l_p moving inside this "wavelength"? It must be $\frac{l_p}{\bar{\lambda}_e}$. The joint probability for both "gravity" events to happen is $\frac{l_p^2}{\bar{\lambda}_e\bar{\lambda}_p}$.[4] In our view, this is the joint-probability of gravity inference between two bodies. For any two bodies, given the joint probability for gravity interaction we get the generalized joint probability of

$$
P(A,B) = P(A)P(B) = \frac{l_p}{\bar{\lambda}_A} \times \frac{l_p}{\bar{\lambda}_B} = \frac{l_p^2}{\bar{\lambda}_A\bar{\lambda}_B} \qquad (13)
$$

where $\bar{\lambda}_A$ is the reduced Compton wavelength in particle mass one and $\bar{\lambda}_B$ is the Compton wavelength in particle mass two.

What we normally call gravity is found in situations where the matter waves are not aligned and thus there is a very low probability of gravity hits. One can also think of gravity as shielding[5], where the shielding area inside the Compton wavelength area is limited to the Planck length. In aligned matter this probability is one. In addition, we have the fine structure constant that is linked to the orbital velocity of the electron.

Further the probability $\frac{l_p^2}{\bar{\lambda}_e^2}$ is also directly linked to the small gravitational coupling constant

$$
\alpha_G = \frac{l_p^2}{\bar{\lambda}_e^2} = \frac{m_p^2}{m_e^2} = \frac{G m_e^2}{\hbar c} \qquad (14)
$$

That the small gravitational coupling constant can be written in this form was recently shown by Haug (2016b). The gravitational coupling constant is often described as the dimensionless gravitational constant and has been discussed in a series of papers in theoretical physics, see Silk (1977), Rozental (1980), Neto (2005), and Burrows and Ostriker (2013), for example. The dimensionless gravitational coupling constant is only dimensionless in the sense that it does not change value if we change the unit systems of the speed of light, for example. It is not dimensionless in the sense that it holds between any two masses. It could be better described as the dimensionless electron gravitational coupling constant, as it gives the gravitational relationship between two electrons relative to that of two Planck masses. For two Planck masses, the gravitational coupling constant is

[4] We are here not taking into account the distance between the masses, that comes in addition in the form of the inverse square law that is found in both the Newton gravitational force formula and in the Coulomb's force formula.

[5] This would be the atomist view of gravity, see Haug (2014) for a extensive introduction to mathematical atomism.

$$\alpha_G = \frac{l_p^2}{l_p^2} = 1 \tag{15}$$

This later coupling constant is a more fundamental dimensionless constant that indirectly shows that the gravitational force is identical to Coulomb's force for Planck masses. In more general terms, the gravitational coupling constant that holds between any two masses (where each mass is uniform) are

$$\alpha_G = P(A,B) = \frac{l_p^2}{\bar{\lambda}_A \bar{\lambda}_B} \tag{16}$$

Where $\bar{\lambda}_A$ and $\bar{\lambda}_B$ are the reduced Compton wavelength of the two masses of interest. In other words, we claim the correct interpretation for the gravitational coupling constant is a joint probability factor that distinguishes gravity from electromagnetism. This should not come as an enormous surprise. In quantum mechanics probabilities plays an important role. In standard gravity theory we have been unaware of probabilities so far, possibly this can be a step in the right direction not only to unify gravity and electromagnetism, but possibly also as a small step in the right direction to unify quantum mechanics with gravity?

4 How the Gravitational Escape Velocity Is Linked to Electromagnetic Escape Velocity, Electron Voltage, and Ionization

Derivation of the standard classical gravitational escape velocity is accomplished by solving the following equation with respect to v_e

$$\begin{aligned} E_k - \frac{GmM}{r} &= 0 \\ \frac{1}{2}mv_e^2 - \frac{GmM}{r} &= 0 \\ v_e^2 &= \frac{\frac{GmM}{r}}{\frac{1}{2}m} \\ v_e^2 &= \frac{2GM}{r} \\ v_e &= \sqrt{\frac{2GM}{r}} \end{aligned} \tag{17}$$

This is the well-known formula for gravitational escape velocity. The formula is actually an approximation for low gravitational fields, which implies for escape velocities $v_e << c$. The escape velocity we will later look at in a electromagnetic field is also $v << c$. Here we will claim that the gravitational escape velocity formula also is linked to the escape velocity needed for electrons to escape an electromagnetic field. However, for such use the gravitational escape velocity must be modified for an aligned (superimposed) gravity field. Indirectly embedded in the gravity velocity formula above is the probability $\frac{l_p^2}{\bar{\lambda}_A \bar{\lambda}_B}$ that holds only for non-aligned matter. This because the gravitational escape velocity is derived from the gravitational potential that also contains this probability compared to electrostatic potential, as we soon will discover.

Derivation of the standard classical gravitational escape velocity, but now with adjustment for "matter alignment" is accomplished by solving the following equation with respect to $v_{e,a}$

$$
\begin{aligned}
E_k - \frac{GmM}{r}\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}\alpha &= 0 \\
\frac{1}{2}mv_{e,a}^2 - \frac{GmM}{r}\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}\alpha &= 0 \\
v_{e,a}^2 &= \frac{\frac{GmM}{r}\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}\alpha}{\frac{1}{2}m} \\
v_{e,a}^2 &= \frac{2GM}{r}\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}\alpha \\
v_{e,a} &= \sqrt{\frac{2GM}{r}\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}\alpha} \qquad (18)
\end{aligned}
$$

The term $\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}$ is used to set the embedded probability $\frac{l_p^2}{\bar{\lambda}_A\bar{\lambda}_B}$ to one. The probability for gravitational impact in aligned matter is one. In addition, we have the fine structure constant α that is used to take into account the orbital velocity of the electron. The orbital velocity of the electron is given by

$$
v_{o,a} = \sqrt{\frac{GM}{r}\frac{\bar{\lambda}_A\bar{\lambda}_B}{l_p^2}\alpha} \qquad (19)
$$

Where r is the radius the electron is orbiting and α is the fine structure constant. For example, the kinetic energy it takes to ionize an electron from a hydrogen atom is now given by

$$
E_k = \frac{1}{2}m_e v_{o,a}^2 \approx 2.1799 \times 10^{-18} \qquad (20)
$$

If we divide this by the elementary charge $e = q_p\sqrt{\alpha} = \sqrt{\frac{\hbar}{c}}\sqrt{\alpha}\sqrt{10^7}$, we get voltage of:

$$
V_e = \frac{1}{2}\frac{c\alpha}{\bar{\lambda}_e}\sqrt{c\alpha\hbar}\sqrt{10^{-7}} \approx 13.6057 \qquad (21)
$$

which is the well-known minimum voltage needed to ionize an electron from the innermost shell of a hydrogen atom.[6] We can also rewrite the escape velocity of the electron based on Haug (2016a) recent simplification in the quantum realm. Assume r is the Bohr radius[7] $r = \frac{\bar{\lambda}_e}{\alpha}$ and we obtain the electron escape velocity away from a proton in a electrostatic field as

$$
\begin{aligned}
v_{e,a} &= \sqrt{\frac{2GM_{proton}}{r}\frac{\bar{\lambda}_p\bar{\lambda}_e}{l_p^2}\alpha} \\
v_{e,a} &= \sqrt{2\frac{\frac{l_p^2c^3}{\hbar}\frac{\hbar}{\bar{\lambda}_p}\frac{1}{c}}{\frac{\bar{\lambda}_e}{\alpha}}\frac{\bar{\lambda}_e\bar{\lambda}_p}{l_p^2}\alpha} \\
v_{e,a} &= c\alpha\sqrt{2} \qquad (22)
\end{aligned}
$$

where $\bar{\lambda}_p$ and $\bar{\lambda}_e$ are the reduced Compton wavelength of the proton and the electron respectively. Further, the electron orbital velocity is equal to

$$
v_{o,e} = c\alpha \qquad (23)
$$

[6]The more general formula that holds for any orbital shell (but only for one electron) is $\frac{1}{2}\frac{c\alpha}{\bar{\lambda}_e}\sqrt{c\alpha\hbar}\sqrt{10^{-7}}\frac{Z^2}{n^2}$, where n is the orbital shell of the electron and Z is the atom's atomic number.

[7]See Appendix A to see that the Bohr radius can be written in this simple form.

This can be generalized to

$$v_{o,e} = Zc\alpha \tag{24}$$

where Z is the atom's atomic number.

Table 2: Orbital velocity and Ionization energy calculated from the modified gravitational orbital velocity formula for the first 10 elements. These calculations are for the electron at the innermost electron shell.

Atomic number:	**Element:**	**Escape velocity m/s:**	**Orbital velocity m/s:**	**Ionization energy eV**
1	Hydrogen	3,093,862.66	2,187,691.27	13.61
2	Hellium	6,187,725.31	4,375,382.53	54.42
3	Lithium	9,281,587.97	6,563,073.79	122.45
4	Beryllium	1,2375,450.63	8,750,765.06	217.69
5	Boron	15,469,313.29	10,938,456.32	340.14
6	Carbon	18,563,175.94	13,126,147.59	489.80
7	Nitrogen	21,657,038.60	15,313,838.85	666.68
8	Oxygen	24,750,901.26	17,501,530.12	870.76
9	Fluorine	27,844,763.91	19,689,221.38	1102.06
10	Neon	30,938,626.57	21,876,912.65	1360.57

5 Escape and Orbital Velocity for an Electron in Aligned Matter

Here we will derive the escape velocity and orbital velocity for an electron around a hydrogen atom directly from electromagnetism by relaying on the Coulomb potential:

$$\begin{aligned}
\frac{1}{2}m_e v_e^2 - k_e\frac{ee}{r} &= 0 \\
\frac{1}{2}\frac{\hbar}{\bar{\lambda}_e}\frac{1}{c}v_e^2 - c^2 10^{-7}\frac{\left(\sqrt{\frac{\hbar}{c}}\sqrt{\alpha}\sqrt{10^7}\right)^2}{r} &= 0 \\
\frac{1}{2}\frac{\hbar}{\bar{\lambda}_e}\frac{1}{c}v_e^2 - \frac{c^2\frac{\hbar}{c}\alpha}{r} &= 0 \\
\frac{1}{2}\frac{\hbar}{\bar{\lambda}_e}\frac{1}{c}v_e^2 - \frac{\hbar c\alpha}{r} &= 0 \\
\frac{v_e^2}{2} - \frac{\frac{\hbar c\alpha}{r}}{\frac{\hbar}{\bar{\lambda}_e}\frac{1}{c}} &= 0 \\
\frac{v_e^2}{2} - \frac{\bar{\lambda}_e c^2\alpha}{r} &= 0 \\
v_e^2 &= 2\frac{\bar{\lambda}_e c^2\alpha}{r} \\
v_e &= \sqrt{2\frac{\bar{\lambda}_e c^2\alpha}{r}} \\
v_e &= c\sqrt{2\frac{\bar{\lambda}_e\alpha}{r}} \qquad (25)
\end{aligned}$$

where m_e is the electron mass, $\bar{\lambda}_e$ is the reduced Compton wavelength of the electron, α is the fine structure constant, and e is the electron charge. If we set r as a function of the Bohr radius $r = a_0 = \frac{\bar{\lambda}_e}{\alpha}$ we get

$$
\begin{aligned}
v_e &= c\sqrt{2\frac{\bar{\lambda}_e\alpha}{r}} \\
v_e &= c\sqrt{2\frac{\bar{\lambda}_e\alpha}{\frac{\bar{\lambda}_e}{\alpha}}} \\
v_e &= c\alpha\sqrt{2} \qquad (26)
\end{aligned}
$$

while the electron orbital velocity is

$$
v_{e,o} = c\alpha \qquad (27)
$$

This is the same formula that we get by using probability intuition combined with the gravitational escape velocity. The orbital velocity can easily be generalized to hold for electron orbits in other electron orbital shells. The more general formula is

$$
v_{e,o} = Zc\alpha \qquad (28)
$$

where Z is the number of protons in the atom of interest.

6 Conclusion

We claim that electromagnetism and gravity ultimately seem to be the same force. Electromagnetism is "gravity" from aligned matter (waves) (superimposed Compton matter waves), while gravity is the same force from unaligned matter (waves). We can say that electromagnetism is strong gravity and gravity is very weak electromagnetism. Based on this view, it is also no surprise that they are the same for two Planck masses. A Planck mass is the densest form a mass can take, and two Planck masses will always be aligned; therefore their gravitational force is identical to their electromagnetic force. The difference between electromagnetism and gravity is related to a joint probability: for aligned matter this probability is one and for non-aligned matter it is equal to the Planck length squared divided by the reduced Compton length of the mass of interest squared. We will end on a light note by saying: May the GravityElectroMagnetic Force be with you!

Appendix A: The Bohr Radius

The Bohr radius is normally given by $a_0 = \frac{\hbar}{m_e c\alpha}$. This can be rewritten as

$$
\begin{aligned}
a_0 &= \frac{\hbar}{m_e c\alpha} \\
a_0 &= \frac{\hbar}{\frac{\hbar}{\bar{\lambda}_e}\frac{1}{c}c\alpha} \\
a_0 &= \frac{\bar{\lambda}_e}{\alpha} \qquad (29)
\end{aligned}
$$

This means that the Bohr radius is $\frac{1}{\alpha} \approx 137.04$ times the electron radius.

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