The Mechanism of Quantum Gravity

E. Physicist
E-mail: EidolonPhysicist@gmail.com

Abstract. General Relativity and Quantum Mechanics have been successful at describing their respective realms, but the two theories remain disjoint. We finesse this difficulty with a classical model of the Universe that unites gravitational, nuclear, and electromagnetic forces. This model is derived by examining the nucleus and its nuclear quanta. Newton's Law of Gravitation evolves into a formula for the gravitational field within an atom's nuclear quantum layers which has the form of Hooke's Law for the potential energy of a spring. The inward force—a reaction to the joint strain caused by introducing two particles into the space—drives particles towards each other. Gravity is not a mysterious attractive force acting at a distance with no mechanism, but a force acting locally with a well-defined mechanism. The force on the nucleons from the spring stress of space on the nucleus provides a physical basis for the strong force of quantum mechanics. The Fundamental Law of Nature gives the relationship between the strong force stress on space, gravity, and the wavelength of a photon. The new paradigm offers an alternative to the Standard Model that is inherently integrated with gravitation.

1. Introduction

We present a new model of the physical Universe. The observations of atomic and small particle/wave behavior are presently modeled by Quantum Mechanics. The observations of very large bodies in space are modeled by General Relativity. Both of these models have been successful at predicting observed phenomena in their respective domains. But they remain intractably separate theories.

The attempt to knit together diverse mathematical models built to describe what appears at the outset to be unrelated physical phenomena is understandably fraught with difficulty. Our admittedly radical approach is to finesse the problem by presenting a single physical model for gravitational and nuclear forces. Building unified mathematical models on top of this unified physical model should then be easier.

How can a return to a physical model be a radical solution in physics? Isn't physics, after all, about physical reality? Yes, but Quantum Mechanics was founded on the assumption that classical physical laws do not apply on the subatomic scale. Suggesting at this point that an answer to the logjam in physics might be to utilize classical laws to explore subatomic physical reality is swimming against a tide running strongly in the opposite direction for over a century.

2. Results

2.1. Quantum law of gravitation

Newton presented his Law of Universal Gravitation in 1687, where the force of gravity ${}_GF$ is given by

$$ {}_GF = G\frac{m_1 m_2}{r^2} \tag{1}$$

where m_1 and m_2 are the masses of two objects, r is the separation of their centers, and G is the Gravitational Constant, first measured 71 years after Newton's death.

Newton's Law of Gravitation shows the force of gravity is dependent on two masses. We isolate a single mass by considering its gravitational field ${}_GU$ at distance r from the center of its mass m:

$$ {}_GU = G\frac{m}{r^2} \tag{2}$$

This expression has units m/s[2], and is the acceleration imparted towards mass m on another object in its gravitational field. (We use italics for variables like mass (m) and normal case for units like meters (m).) Equations (1) & (2) imply that the gravitational field extends indefinitely from the object across the Universe.

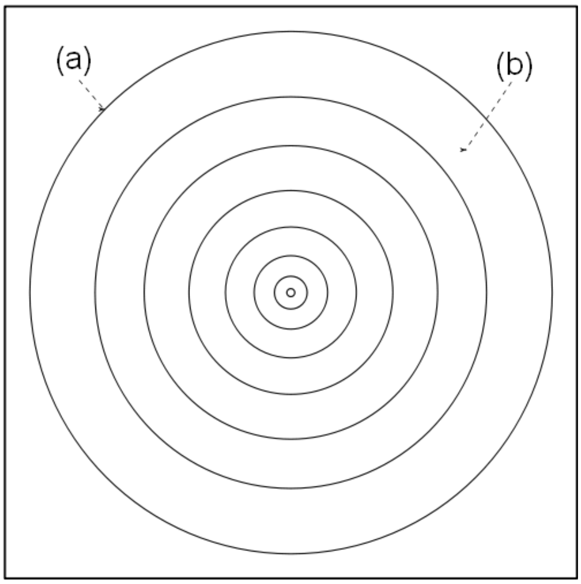

Figure 1. Bohr model of an atom. This figure illustrates the first 8 quantum levels. (a) Quantum level 8; (b) Quantum layer 8. Drawn to scale: the radius of each quantum level is proportional to the square of its quantum number. The nucleus is 10^4 or 10^5 times smaller than quantum level 1, depending on the element. The Bohr model was introduced in 1913. Since replaced by more complex models, its simplicity and clarity still make it a useful starting place for any model of atomic phenomena.

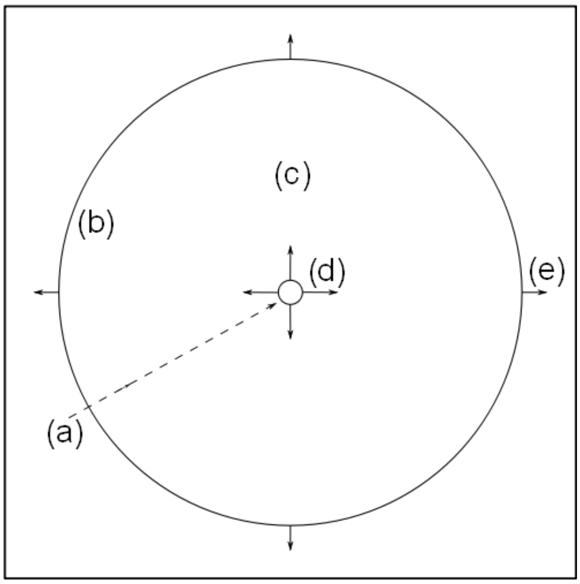

Figure 2. Particle creation. (a) Particle. (b) Quantum level 1. (c) Quantum layer 1. (d) Stress of introducing a particle into space causes strain in quantum layer 1: it acts like a spherical, double-ended, compressed spring. (e) Stress is transmitted to quantum layer 2 in proportion to the surface area of quantum level 1. This sets the stage for— but does not itself induce—gravitation. A second particle is required to interact with this one before gravitation arises. (Not drawn to scale.)

Figure 1. illustrates the Bohr model of the atom, in which electrons circle the nucleus in disjoint, spherical shells. The quantum levels of an atom do not stop with the level of an outmost trapped electron but instead extend throughout space. In our model, we imagine that each elementary particle or nuclear group thereof has such quantum levels.

Previously, quantum levels in physics have implicitly referred to these electron quantum levels. But consider Figure 3, which shows that measurement of the ^{1}H nucleus by electron scattering shows a fuzzy radius to the nucleus which is 50% larger than the proton, its sole occupant. This is evidence of what is called the “nuclear skin”, present around all nuclei [10]. Furthermore, the radius of the border is equal to the wavelength of the proton given by $\lambda_p = {}^{h}/_{{}^{p}E}$ = 1.26 x 10^{-15}m where h is the Planck constant and ${}^{p}E$ is the energy required to create the proton (less the quarks[1].) We will call this radius the first nuclear quantum level, designating nuclear quantum levels with the Hebrew letter nun, נ , to distinguish them from electron quantum levels denoted by *n.*

[1] Quark energy creation is excluded to isolate the energy for creation of the proton itself. More on this below.

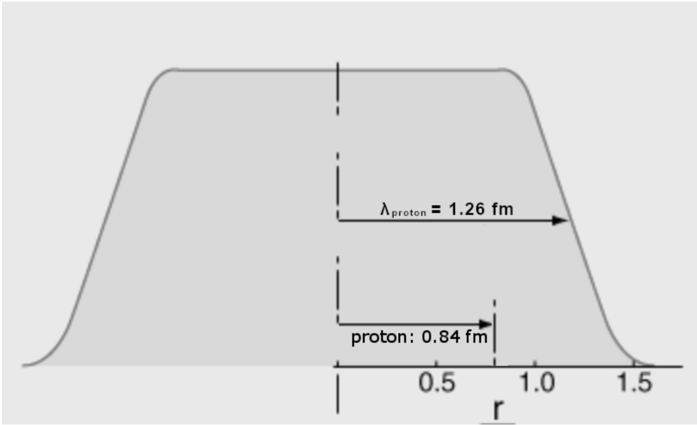

Figure 3. The radius of the ^{1}H nucleus, measured by electron scattering, is larger than the proton, its only occupant, and is approximately equal to the wavelength of the proton.

Applying (2) to an atom with A nucleons at a distance of quantum level נ, נ an integer > 0, gives

$$^{A}_{G}U_{\text{נ}} = G\frac{^{A}m}{^{A}\text{ר}_{\text{נ}}^{2}} \tag{3}$$

where ^{A}m is the mass of the nucleus, $\text{ר}_{\text{נ}}$ is the distance of the נ^{th} quantum level from the center of the nucleus and G is the gravitational constant introduced by (1). (ר denoting the quantum level radius here is the Hebrew letter resh.) An important implication of (3) is the consistency of the gravitational field throughout each quantum layer (Figure 1(b).)

We start with the formula for the radius of the נ^{th} nuclear quantum level of the nucleus with A nucleons, borrowing from the analogous formula for the electron quantum levels in the Bohr model:

$$^{A}\text{ר}_{\text{נ}} = {}^{A}\text{ר}_{1} \cdot \text{נ}^{2} \tag{4}$$

where $^{A}\text{ר}_{1}$ is the radius of the first nuclear quantum level. Constants like $^{1}\text{ר}_{1}$ are listed in Table 1.

Table 1. Table of Physical Constants.

Symbol	Value	Units	Meaning
G	6.67×10^{-11}	$m^3/kg \cdot s^2$	Gravitational constant [4]
$^{1}\text{ר}_{1}$	1.33×10^{-15}	m	Radius nuclear quantum level 1 of ^{1}H (= λ_{proton}) [7][2]
m_p	1.67×10^{-27}	kg	Mass of proton less quarks [2]
$^{1}\text{א}$	1.41×10^{-7}	m/s^2	Quantum gravitational constant (8)
$^{1}r_0$	0.84×10^{-15}	m	Physical radius of ^{1}H nucleus [2]
r_p	0.84×10^{-15}	m	Radius of a proton [2]
$^{1}_{G}U$	6.85×10^{-8}	m/s^2	Nucleon Gravitational Acceleration
ג	8.35×10^{-2}	Nm/s^2	Strong Gravitational Constant (25)

[2] A deprecated value of proton creation energy led to a smaller value for $^{1}\text{ר}_{1} = \lambda_{proton}$ (1.26×10^{-15}) [7]. As data accuracy improves for underlying values, these proposed constants will also improve in accuracy.

Using (4), (3) becomes

$$ {}_{G}^{A}U_{\text{נ}} = G\frac{{}^{A}m}{{}^{A}\text{ר}_{1}^{2}\cdot \text{נ}^{4}} \tag{5}$$

We notice that ${}^{A}m$ is just $A{\cdot}m_p$ where m_p is the mass of the proton less its quarks[3]. This permits us to write (5) as

$$ {}_{G}^{A}U_{\text{נ}} = \frac{Gm_p}{{}^{A}\text{ר}_{1}^{2}}\left(\frac{A}{\text{נ}^{4}}\right) \tag{6}$$

Evaluating the total for a single proton by summing from $\text{נ} = 1$ to ∞ we get ${}_{G}^{1}U$ = 6.85469e-8 m/s², which is the acceleration due to a single nucleon, or the Nucleon Gravitational Acceleration. It turns out that whether one uses (6) and substitutes A for an arbitrary nucleus, or instead simply multiplies A times the Nucleon Gravitational Acceleration, the resulting gravitational field of the nucleus with A nucleons is numerically the same. So ${}_{G}^{A}U$ = (6.85469e-8 · A) m/s².

To improve our understanding and simplify this expression we define

$$ {}^{A}x_{\text{נ}}^{2} = \frac{A}{\text{נ}^{4}} \tag{7}$$

Note that this is simply A times the Riemann Zeta function ζ(4) and ζ(4) = $\pi^4/90$.

Define ${}^{A}\aleph$ (using aleph, the first letter of the Hebrew alphabet) as

$$ {}^{A}\aleph = \frac{2Gm_p}{{}^{A}\text{ר}_{1}^{2}} \tag{8}$$

which enables us to express (6), the "quantum law of gravitation":

$$ {}_{G}^{A}U_{\text{נ}} = \frac{1}{2}\,{}^{A}\aleph \cdot {}^{A}x_{\text{נ}}^{2} \tag{9}$$

This has the same form as the potential energy of a spring as given by Hooke's Law: ${}^{A}\aleph$ is the spring constant, and ${}^{A}x_{\text{נ}}^{2}$ is the strain on (i.e., compression of) the spring. So (3)— the gravitational field of the nucleus of an element with A nucleons at nuclear quantum level נ—is analogous to the potential energy of an elastic spring at quantum level נ with spring constant ${}^{A}\aleph$ and displacement ${}^{A}x_{\text{נ}}^{2}$. But ${}_{G}^{A}U_{\text{נ}}$ is not potential energy: it has units of acceleration. This is because unlike a normal spring, gravity accelerates all objects at the same rate. Shortly we shall see why.

We turn our attention first to understanding ${}^{A}x_{\text{נ}}^{2}$ better. As an acceleration ${}_{G}^{A}U_{\text{נ}}$ has units of m/s², and all the units are in ${}^{A}\aleph$. This is expected since deformation of springs is usually expressed as a unit-less ratio.

Now we need the usual model of the radius ${}^{A}r_0$ of the atomic nucleus of an element with A nucleons [1] (adopting a convention that quantum level "0" is the edge of the physical nucleus):

---

[3] In [8] we end up assuming that the difference in proton and neutron creation energy is only due to the difference in their quark composition, and hence they have the same radius, volume, and consequently gravitational attraction.

$$ {}^{A}r_0 = {}^{1}r_0 \, A^{\frac{1}{3}} \tag{10}$$

This heuristic together with (4) yields an expression for the displacement of the "gravitational spring":

$$ {}^{A}x_{\text{ן}}^2 = \frac{{}^{A}S_1}{{}^{A}S_{\text{ן}}}\frac{{}^{A}V_0}{{}^{1}V_0} \tag{11}$$

The displacement of the "gravitational spring" in the ןth quantum level depends inversely on the ratio of the surface area of the ןth quantum level to the surface area of the first quantum level, and directly on the ratio of the volume of the nucleus of an element with *A* nucleons to the volume of the ^{1}Hydrogen nucleus. As the product of these two ratios, it is without dimension. Strain is determined entirely by the geometry of the atom and its quanta.

This observation has implications on the nature of space itself. Our understanding of space is growing. We know the speed of light in space depends on the permittivity and permeability of space; just as does the speed of light in water or glass depend on those characteristics of those materials. Furthermore, the conclusion of Einstein's General Theory of Relativity—that space is curved in the presence of a gravitational mass—also implies that space is more than a totally empty void cavity. (But to be honest, this is not an argument that we should use here. We will show that space is not actually curved, but rather that particles in the presence of each other behave as though it were. The mathematics of General Relativity permit Newton's Laws to operate in a gravitational field, and that mathematics can be interpreted to mean that space has curvature in a gravitational field. But the mathematics do not curve space. You can make a model of reality but that does not inversely create a reality of the model.) In any case, all this is evidence that something fishy is going on with space, and we need to reveal the actual mechanism at work.

One way to interpret the direct dependence of displacement ${}^{A}x_{\text{ן}}^2$ upon the volume of the nucleus is that when an element is created, it does not replace space: it *displaces* the space that it now occupies. This is analogous to the insertion of a ball bearing (the nucleus) into a foam rubber block (the Universe.)

Think of the insertion of the nucleus into the Universe as creating a pressure outward on the space within the first quantum layer (Figure 2(d).) This pressure is distributed equally around the surface of the nucleus. Using the spring analogy, space is "compressed". Think of this space as staying inside the quantum level but being placed under stress by the strain of insertion. This stress creates an outward pressure on the quantum level 1, distributed around the surface area of the quantum, just as a compressed spring applies equal pressure to both ends. The pressure is the same at every quantum level, so as the surface area increases, the force applied to each surface decreases in proportion. Thus, the pressure is the same on the inner surface and the outer surface of each quantum layer. The pressure exerted outward at quantum level 1 induces a stress on the 2nd quantum layer. And so on throughout the Universe.

It may be worth mentioning that the Michaelson-Morley experiments of the late 19th century, which led to Special Relativity, also dispelled the then-popular concept that space was a" luminiferous æther"—a medium in which light waves propagated much like water waves propagate in water. This resulted in the conclusion that space was really nothing. This was an overreaction. It has taken another century to consider that space itself might have characteristics which could more easily explain the strange phenomena that gave rise to quantum mechanics and concurrently the mechanism of gravitation.

This model asserts that gravitational acceleration is a side effect of the strain on space. A more elaborate model of this effect will be discussed when we have characterized a few more details about the nucleus.

Now let A = 1 and ℶ = 1, the first nuclear quantum level of ^1H. By applying (7) for this case to (9) we see that the gravitational acceleration at the first quantum of ^1H is $^1\aleph/2$. The spring constant $^1\aleph$ is easy to evaluate from (8) using the other constants in Table 1:

$$^1\aleph = 1.41 \times 10^{-7} \tag{12}$$

The quantum law of gravitation (9) replicates applying Newton's Law of Gravitation to the nucleus of an atom.

2.2. The fundamental law of nuclear gravitation

We want to look more closely at the insertion of a particle into space and the effect it has on the Universe. Consider formation of a single proton.

The energy necessary to create the proton is 938 MeV, but the energy needed to create its components, two up quarks and a down quark, amounts to only about 5 MeV [9]. By our model the remaining 933 MeV is used to set the gravitational spring. This is placed into the volume of the proton; dividing the former by the latter gives the pressure from the proton to the gravitational spring, i.e. between the proton and the inner surface of the spherical shell surrounding it (Figure 4(d).) This pressure in N/m^2 is

$$^1P = \frac{^1E}{^1V_0} = 5.98 \cdot 10^{34} \tag{14}$$

where ^1P is the pressure the proton is putting on the space, ^1E is the proton formation energy left over after quark formation in Nm, and $^1V_0$ is the volume of the proton. This is distributed around the surface of the proton (Figure 4(e).) The equal and opposite force on the proton (in Newtons, Figure 4(g)) is the pressure times the surface area:

$$^1_SF_0 = {^1P}\,{^1S_0} = 5.33 \cdot 10^5 \tag{15}$$

where $^1S_0$ is the surface area of the proton. $^1_SF_0$ is equivalent to what in the Standard Model is called the strong force holding the quarks together inside the proton. As we generalize to multiple particle nuclei $^A_SF_0$ becomes equivalent to the residual strong force, holding nucleons together in a nucleus with A nucleons. In our model this is the stress force placed on the particles in the nucleus. This single compressive force performs both functions. (In [8] we discuss in detail the role that mass defect plays in keeping the nucleus together, which combines with the residual strong force to retain nuclear integrity.)

Neutrons outside a nucleus normally decay into a proton and electron (and an anti-neutrino) in 14 minutes and 46 seconds [2]. But deuterium, ^2H, is stable with one neutron and one proton in the nucleus. This nucleus has the shape of a capsule, roughly two hemispheres joined by an indented cylinder as shown in Figure 6. Using this surface area gives $^2_SF_0 = 8.70 \times 10^5$ N, or about 60% higher than for the single proton (15). Perhaps this is more than enough extra force to hold the neutron together, whereas subject only to the pressure of (15) on its own, the neutron decays. (In [8] we present an additional reason for the neutron not decaying in the nucleus.)

This is a strong force indeed: the opposing force of two positively charged protons in the spherical nucleus of ^{4}Helium is at most 81.4N if the protons are touching, and the strong force $^4_SF_0$ on the ^4He nucleons is at least 1.5 that of deuterium or 1.30 x 10^6N. (This is a bit of an oversimplification due to mass defect effects [8], and our lack of detailed knowledge as to how space wraps around the particles at the nucleus providing the so-called "nuclear skin" [10], but the order of magnitude is likely correct.)

By this model the strong force of the gravitational spring is enough to hold the quarks together inside protons. According to our model the

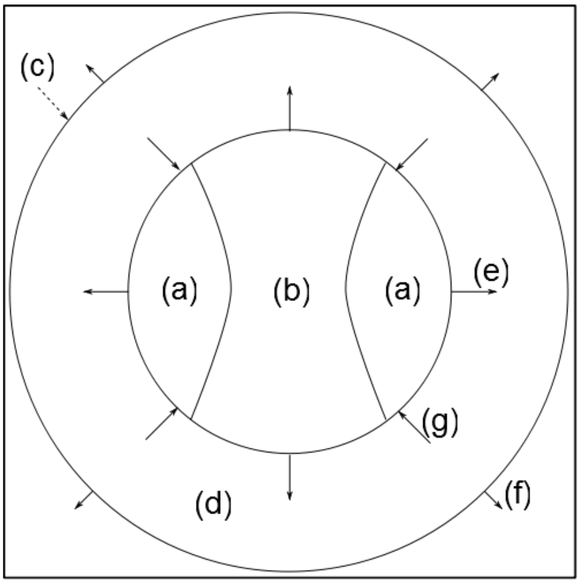

Figure 4. The nuclear spring. The proton is composed of two up quarks (a) and one down quark (b). The outer circle is the measured edge of the nucleus (c): quantum level "1"; (d) is quantum layer "1". (e) Placing the proton into the space compresses it. (f) The stress of compression is transmitted to the next quantum layer. (g) The equal and opposite force to (e) is the strong force holding the quarks together in the proton. Drawn to scale.

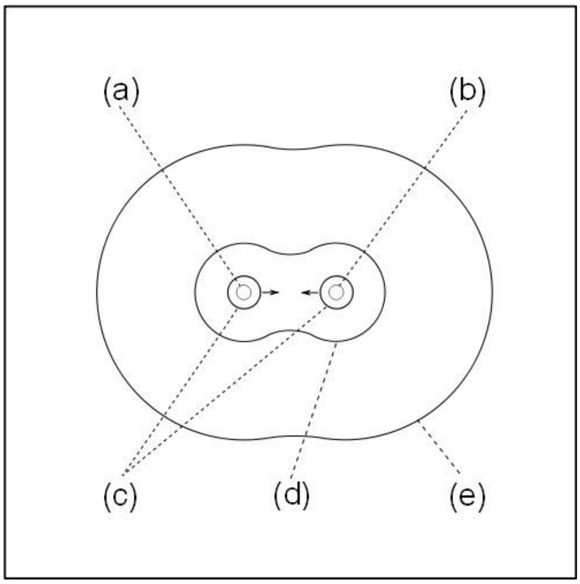

Figure 5. Gravitation. Two particles: (a) Proton. (b) Neutron. (c) Quantum levels "1": measured edge of each single particle nucleus. (d) Quantum level 2. (e) Quantum level 3. The lower energy state achieved as the infinite quantum layers coalesce gives rise to the acceleration called gravitation (arrows.) The pressure on the shrinking capsules requires less force to maintain because the capsules have less surface area than the two combining spheres. Not drawn to scale.

strong force of the Standard Model now has a physical basis: the force of setting the gravitational spring within the nucleus.

The strong force in the case of a nucleus with A nucleons is

$$ {}_{S}^{A}F_0 = {}^{A}P\,{}^{A}S_0 \tag{16}$$

Extending (14) to the element with A nucleons, where (neglecting binding energy) ${}^{A}E = A\,{}^{1}E$ gives us

$$ {}_{S}^{A}F_0 = \frac{A\,{}^{1}E}{{}^{A}V_0}\,{}^{A}S_0 \tag{17}$$

Expanding the volume and surface area in terms of the radius ${}^{A}r_0$ and canceling, (17) reduces to

$$ {}_{S}^{A}F_0 = \frac{3A^{\frac{2}{3}} \cdot {}^{1}E}{{}^{1}r_0} \tag{18}$$

As the nucleon count rises, the strong force initially increases rapidly with $A^{\frac{2}{3}}$, but then tapers off. Our model would suggest that there will be a point where the incremental strong force would be insufficient to hold the nucleus together, and radioactive decay ensues. (In [8] we suggest another possible reason for this decay: the nucleons do not bind together perfectly, and eventually thermic stresses break them apart along weak seams.) In contrast the Standard Model tells us the residual strong force retains particles in the nucleus. Beta radioactivity due to decay of a neutron in the nucleus is then due to the weak force. But our model argues that the compressive force of space is the only force we need consider, and that the weak force of quantum mechanics is really the stress on space (and inter-particle bonds [8]) becoming too weak to do the job. In this model there is no need for a weak force. There is just the strong force, gravitation, and as we shall see shortly, electromagnetism.

The strong force is transmitted to the observed edge of the nucleus (nuclear quantum level 1) in inverse proportion to its surface area:

$$ {}^{A}_{S}F_1 = {}^{A}P\,{}^{A}S_1 = \frac{{}^{A}F_0}{{}^{A}S_0} \cdot {}^{A}S_1 \tag{19}$$

which likewise applies to the ג^{th} quantum level

$$ {}^{A}_{S}F_{\text{ג}} = \frac{{}^{A}F_0}{{}^{A}S_0} \cdot {}^{A}S_{\text{ג}} \tag{20}$$

Restating (18) by reverting to ${}^{A}r_0^3$ in the denominator

$$ {}^{A}_{S}F_{\text{ג}} = \frac{3A\cdot{}^{1}E}{{}^{A}r_0^3} \cdot {}^{A}\text{ר}_1^{2} \cdot \text{ג}^{4} \tag{21}$$

Restating (9) using (8) gives

$$ {}^{A}_{G}U_{\text{ג}} = \frac{1}{2}\,{}^{A}\text{א} \cdot \frac{A}{\text{ג}^{4}} = \frac{Gm_p}{{}^{A}\text{ר}_1^{2}} \frac{A}{\text{ג}^{4}} \tag{22}$$

Noting that ${}^{1}r_0 = {}^{1}r_p$, the product of Eqs. (21) and (22) is

$$ {}^{A}_{S}F_{\text{ג}} \cdot {}^{A}_{G}U_{\text{ג}} = \frac{3\cdot Gm_p{}^{1}EA}{{}^{1}r_p^3} \tag{23}$$

By the Special Relativity approximation ${}^{1}E = m_p c^2$,

$$ {}^{A}_{S}F_{\text{ג}} \cdot {}^{A}_{G}U_{\text{ג}} = \frac{3\cdot G\cdot{}^{1}E^2\cdot A}{{}^{1}r_p^3\cdot c^2} \tag{24}$$

To distill this relationship let us define the Strong Gravitational Constant, **ג** (Hebrew letter gimel) as the constant

$$ \text{ג} = \frac{3\cdot Gm_p{}^{1}E}{{}^{1}r_p^3} \tag{25}$$

$$ \text{ג} = \frac{3\cdot G\cdot{}^{1}E^2}{{}^{1}r_p^3\cdot c^2} \tag{26}$$

Then (23) becomes the “fundamental law of nuclear gravitation”:

$$ {}^{A}_{S}F_{\jmath} \cdot {}^{A}_{G}U_{\jmath} = \lambda A \tag{27} $$

where in Nm/s^2

$$ \lambda = 8.35 \times 10^{-2} \tag{28} $$

(24) shows that, for a given nucleus, the product of the strong force and the gravitational force is a constant at every quantum level. Both depend on the same surface area governed by the inverse square law. It is clear in (26) that λ depends on the Gravitational constant, the energy required to make the bubble in space which is the proton, and the volume of the bubble created which depends on the cube of the proton radius. This ties the strong force directly to the gravitational force.

Geometrically, the radius of the nucleus ${}^{A}r_0$ is the absolute displacement of the spring. The geometry of the initial condition of the insertion of the mass into space has a fundamental effect on all the outgoing quanta. This is an unexpected geometrical component of more massive objects (nuclei) having a stronger gravitational field, and complements our hypothesis that space is strained by the insertion of each new particle.

Let us return now to the assertion that gravitation is a side effect of the strain placed on space by insertion of the particle. At first it might seem gravity is simply the effect of the compressive forces in the displaced quantum layers, but that neglects the equal and opposite force of the stress on space at each quantum level. Based on force alone, everything is in equilibrium once the particle is created, and there is no reason for particles to move towards rather than away from one another: the forces at the two ends of a spring—and at each quantum level—are equal and opposite, consistent with Newton’s Third Law. But then, what causes gravitational acceleration?

Consider the two particles in the nucleus of ${}^{2}H$ (deuterium): a proton and a neutron. The nuclear boundary forms a capsule shape around the two particles (Figure 6(1), analogous to the spherical shell at Figure 4(c) for a single particle.) Imagine forcing these two particles apart. The nuclear skin capsule starts to collapse, and finally snaps into the form of two separate particles. To do this one must overcome the inward force of the spring, ${}^{2}_{S}F_0$. But all the outer coincident quantum levels are still acting like a capsule-shaped spring and must be forced apart (Figure 4 (d) & (e)), or they will naturally approach each other. Gravitation results from the lower energy state which is achieved as quantum levels of the two particles become aligned; lower, because a capsule has less surface area than the two separate spheres, permitting less force to sustain greater pressure. As the particles approach each other, the surface area continues to decline. Kinetic energy is released in the form of acceleration as the alignment is achieved, and is required to undo the alignment to separate the particles. By this model the infinite quantum levels of at least two particles all contribute to create acceleration due to gravity.

Another way to think about this is to consider Eq. (4) to describe the natural radius of the $\jmath^{th}$ quantum level. As the two $\jmath^{th}$ quantum levels of two particles first touch at the twice the distance given by (4), they then merge into a single, stretched out quantum level $\jmath$ (Figure 6(1).) That new, oblong, merged quantum level $\jmath$ wants to restore to the spherical radius given by (4), which it will approach when the two particles fuse. Until then, that restoring force is the $\jmath^{th}$ quantum level’s contribution to the gravitational force between the two particles. If the first particle is part of you and the second particle is part of the earth, you can see how all your particles’ quantum levels merged with those of all the particles of the earth result in the gravitational pull of the earth on your body (and vice versa.) Sideways pulls by particles to the side are cancelled, but the downward component of each particle is additive.

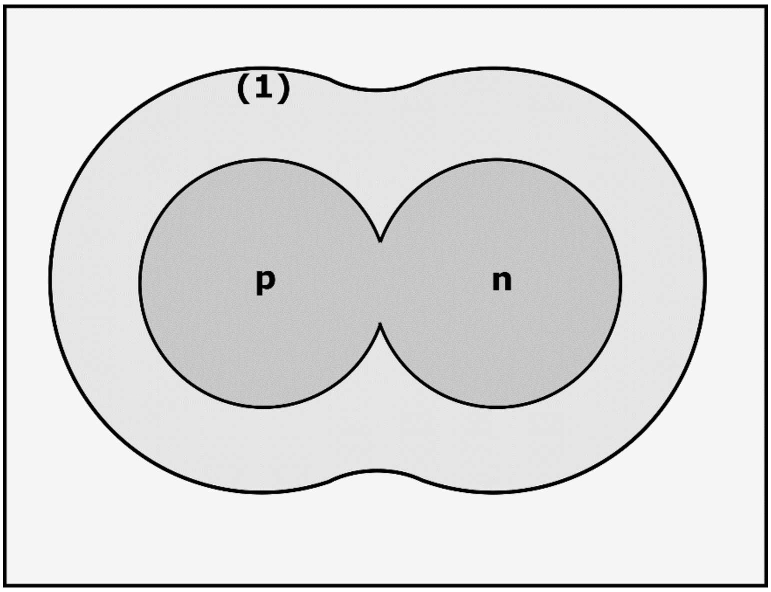

Figure 6. Deuterium composed of a proton “p” and an neutron “n”. The first nuclear quantum level, surrounding the “nuclear skin” [10] and Figure 3, is labeled by (1).

2.3. The Fundamental Law of Nature

We turn our attention to that other quantum phenomenon: the production of a photon as an electron drops down a quantum level, from electron quantum level *n* to level *n-1*. For hydrogen-like atoms, the wavelength of the light emitted is related to the change in energy ΔE required for the transition:

$$f = \frac{c}{\lambda} = \frac{\Delta E}{h} = R\,Z^2\left(\frac{1}{(n-1)^2} - \frac{1}{n^2}\right) \tag{29}$$

where f is frequency, λ is wavelength, c is the speed of light, h is the Planck constant, and R is the Rydberg constant for hydrogen-like (i.e. single electron) atoms with Z nuclear protons [3].

Our model suggests the stress on space within quantum layers is applying a force on electrons that is keeping them in their quantum levels between the layers, and preventing them from radiating energy. An indication that this may be the case is the way electrons are repelled from the heavily compressed space in the nucleus between the proton and nuclear quantum level 1 (Figures 3 and 4(d).) In fact, it seems likely that permittivity and/or permeability are modified as a result of the strain. Call the resulting impediment to electron passage the “quantum layer force”, or “quantum force” for short.

The energy change from Bohr electron quantum level n to quantum level $n-1$ would be this quantum force times the distance between the levels (assuming the electron follows a path in line with the centre of the nucleus):

$$\Delta E = {}^{Z}_{Q}F_n(r_n - r_{n-1}) \tag{30}$$

You will have noticed the use of the *n* subscript on ${}^{A}_{G}U_n$, because we are discussing the electron quantum levels here. How does this relate to the nuclear quantum levels denoted by נ? Numerically, נ = 206 is within 0.12% of n = 1, נ = 412 is within 0.12% of n = 2, and so on, giving us an approximation for navigating between them:

$$\text{נ} = 206 \cdot n \tag{31}$$

The integer factor 206 and the precision of the coincidence of these two types of quantum levels is sensitive to current measured values of ${}^{1}\text{ר}_{1}$ and ${}^{1}r_1$.

Using (29) and solving (30) for quantum force gives

$${}^{Z}_{Q}F_n = \frac{hR\,Z^2\left(\frac{1}{(n-1)^2}-\frac{1}{n^2}\right)}{(r_n - r_{n-1})} \tag{32}$$

Consider first the ratio of the quantum force in layer $n > 2$ to the same force in quantum layer 2, the lowest quantum across which a photon can be generated.

$$\frac{{}^{Z}_{Q}F_n}{{}^{Z}_{Q}F_2} = \frac{\frac{R_M Z^2}{(r_n - r_{n-1})}\left(\frac{1}{n^2} - \frac{1}{(n-1)^2}\right)}{\frac{R_M Z^2}{(r_2 - r_1)}\left(\frac{1}{2^2} - \frac{1}{1^2}\right)} \tag{33}$$

Using (4) this becomes—with a bit of algebra—simply

$$\frac{{}^{Z}_{Q}F_n}{{}^{Z}_{Q}F_2} = \frac{4}{n^2(n-1)^2} \tag{34}$$

Similarly comparing the strong force (21) on quantum level *n* to the 2*nd* level gives

$$\frac{{}^{A}_{S}F_n}{{}^{A}_{S}F_2} = \frac{16}{n^4} \tag{35}$$

The quantum force can be compared to the strong force in each quantum layer by taking a ratio of the (34) and (35):

$${}^{Z}_{Q}F_n = \frac{n^2}{4(n-1)^2}\frac{{}^{Z}_{Q}F_2}{{}^{A}_{S}F_2}\,{}^{A}_{S}F_n \tag{36}$$

The model asserts that the strain on the quantum layer created by the insertion of the particle into space creates stress in that layer which in turn exerts the force an electron must overcome to leap up to the next highest quantum level. In effect the strong force stress on space keeps electrons at their quantum levels. In particular it likely keeps the electron at quantum level 1 from every approaching the nucleus, no matter how many protons it contains. It seems to prevent electromagnetic radiation from the electrons as they accelerate around the nucleus. The most fundamental electromagnetic phenomena are thus tied to the nuclear strong force. Combining (36) with (27) yields the "Fundamental Law of Nature":

$${}^{Z}_{Q}F_n = \frac{\text{ג}An^2}{4(n^2-1)^2} \cdot \frac{{}^{Z}_{Q}F_2}{{}^{A}_{S}F_2 \cdot {}^{A}_{G}U_n} \tag{37}$$

For any atom this is the relationship between the quantum force on the electron (which determines the wavelength of the light photon produced) and the acceleration due to gravity, mediated by the strong force. Analogous to (27), the product ${}^{Z}_{Q}F_n \cdot {}^{A}_{G}U_n$ is constant.

2.4. Discussion

No model is causal: it is only descriptive, and its usefulness ultimately depends on its simplicity, scope (i.e., breadth of applicability), elegance and its ability to describe and predict new details about reality. Furthermore, it cannot be refuted merely by comparison with another model. Many models can be constructed to describe the same phenomena; only experimental evidence can limit a model's scope.

By our model, space displacement creates the strong force and supplants the weak force; if useful this finding will have impact on current theories. The full consequences for quantum mechanics of a compressive force acting on elementary particles and the nucleus remains to be evaluated.

The scattering of electrons by the strained space in the nucleus is the clearest evidence for this model (Figures 3 & 6.) And the Standard Model shows no way for neutrons to congregate, while this model explains the existence of tetraneutrons: clusters of 4 neutrons in a nucleus [6]. Dark matter could simply be gravitationally assembled neutron nuclei. The model holds promise for solving other mysteries. Being only 0.5% of the proton's mass, quarks may be structures of struts supporting the proton void in space. This concept is explored in [8]. This implies space has surface tension: light photons may be small voids supported merely by the surface tension of space without the need for supporting struts. The compressed space around a bubble in space leads to a simple explanation of the wave-particle duality: rather than being an existential choice based on observation as claimed by quantum mechanics, the wave comes into existence when the particle does. It is the existence of quarks inside particles that precludes them from reaching the speed of light in a vacuum [7].

Our model is intuitively pleasing compared to mysterious gravitational attraction acting at a distance. Finally, we can understand why things fall.

2.5. Acknowledgements

The author is indebted to Ray Trattles for his insightful comments which led to a much improved derivation of the Atomic Law of Gravitation. The author would also like to thank Rick Sebastian for his thoughtful consideration of these ideas as they emerged. Thanks also to Karla Blake, Graeme Strange, Andrew Cohen, Steven Nagy, Paul Glavich, Philip Beadle, Andrew Cohen, Paul Kilian and Shawn Blake for their encouragement and comments, and Shane Wright for his erudition.

3. References

[1] Krane, K. S., 1988 *Introductory Nuclear Physics*, (USA & Canada, John Wiley & Sons, Inc).
[2] C. Amsler et al., (Particle Data Group) 2008/9/10 *Phys. Lett. B667*, 1 Available: http://pdglive.lbl.gov. Accessed: 15 July 2009.
[3] *The NIST Reference on Constants, Units, and Uncertainty* http://physics.nist.gov/cuu/Units/meter.html. Accessed: 24 September 2008.
[4] Fixler J B, Foster G T, McGuirk J M and Kasevich M A 2007 Atom interferometer measurement of the Newtonian constant of gravity, *Science* 5 Jan.
[5] Nave C R, 2005 Nuclear size and density *HyperPhysics* http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/nucuni.html#c4. Accessed: 20 September 2008.
[6] Marqus F M 2002 Detection of neutron clusters *Phys. Rev. C* **65.**

[7] Physicist, E., *Additional Insights into Fusion*, https://NewPhysics.Academy (accessed 2022-02-28).
[8] Physicist, E., *The Mechanism of Nuclear Fusion,* https://NewPhysics.Academy (accessed 2022-02-28).
[9] http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html, Nuclear Physics ➔ Nuclear Size (accessed 9 Feb 2022).
[10] Cook, N.D., *Models of the Atomic Nucleus*, Springer-Verlag, 2005.

