Additional Insights into Fusion

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Since the discovery of cold fusion in 1989, no theoretical model has been able to fully account for the observed phenomena. This is in part because, although nuclear binding energy is the best measured property of fusion, no previous model of the nucleus has accurately explained the experimental data for small nuclei. Current models either get the general shape of the curve right but the magnitudes wrong or get closer to the magnitudes but deviate from the shape of the curve. We summarize our previous work which overcomes these difficulties, illustrate some models of atomic nuclei not previously published, and discuss more recent developments which together provide a convincing tapestry supporting the radical notions which have led to an accurate model of fusion.

The New Physics (TNP) is based on a simple idea: when a particle is created it *displaces* the space that used to occupy its new position in the universe, rather than replacing the space as has been previously assumed. is a paradigm shift in physics stemming from the observation that we know a lot more today than was known 100 years ago when first attempting to explain the unexpected behaviours observed at subatomic scale. At the time the conclusion was that normal physics did not apply at subatomic scale. TNP maintains that normal physics does apply at subatomic scale; it is space that has properties but which are only observable at that scale. In particular the effect of creating a particle places stress on the surrounding space [2].

A complete discussion of the set of models comprising TNP is beyond the scope of this paper. But the fundamental hypothesis is that when a particle is created, it does not replace the space that formerly occupied its position: it *displaces* that space. The space surrounding the particle is "compressed" in layers: the nearest layer has measurably higher permeability and permittivity than space far from particles, an effect which appears to decrease with each successive layer. For a discussion of some of the evidence that this hypothesis might be correct, see the companion paper [3].

This hypothesis leads to a radically different view of fundamental particles and photons. It continues along the lines that the energy which forms fundamental particles in fact is consumed in two ways: (1) to form a bubble in space (the particle), and—if the bubble is large enough—then (2) to form quark fragments into a structure which braces the bubble open. Equally as startling as the radical discovery early in the last century that atoms are largely empty, we would now have protons and neutrons so empty they don't even have space inside! In fact, aside from the quarks we only have energy and space in our universe. Mass is a side-effect of the manner in which space is fractured about the particle, and the property all quantum levels have of wanting to maintain their "home position" relative to a particle. The original paper on this proposal discusses how gravity and inertia emerge from this model[1].

Chart 1 illustrates the experimental data, showing how Binding Energy / Nucleon increases as nucleons (protons and/or neutrons) are added to the nucleus to make new nuclei or isotopes. It is the Binding Energy that is released during fusion.

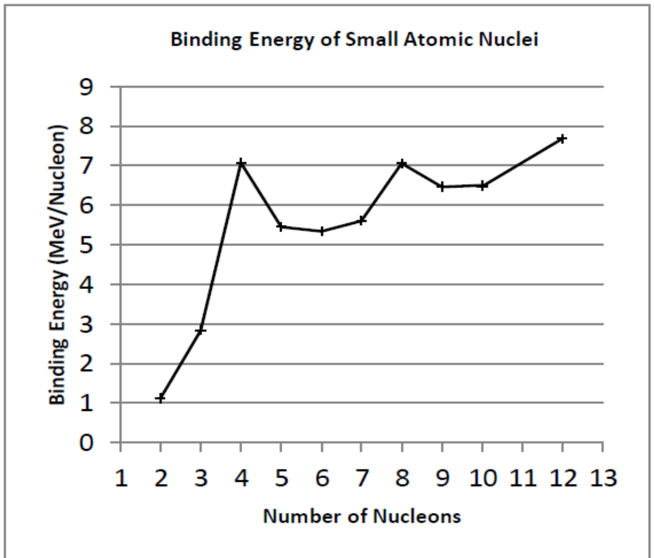


Chart 1. Experimental data on Binding Energy.

For the past 80 years physicists have been trying to explain the non-monotonic (sawtooth) growth in energy per nucleon in this chart. The chart includes isotopes of the elements Helium, Lithium, Beryllium, Boron and Carbon.

The first idea put forth to explain the sawtooth curve was the Liquid Drop Model proposed by Gamow in 1929 and refined ever since to this point:

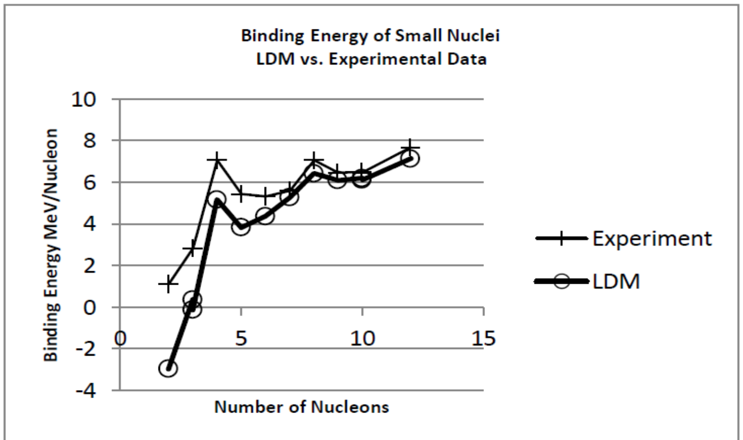


Chart 2. Liquid drop model v. Experimental data

This model treats the nucleus and the nucleons like liquid drops combining, and the shape of the curve seems right (correlation 0.981) but the accuracy is not very convincing (55.6%.)

About 1985 Cook[5] proposed the nucleus might act like a face-centred-cubic crystal:

This shows much improved accuracy to 10.9%, but the shape of the curve is not quite right and correlation falls off to 0.915.

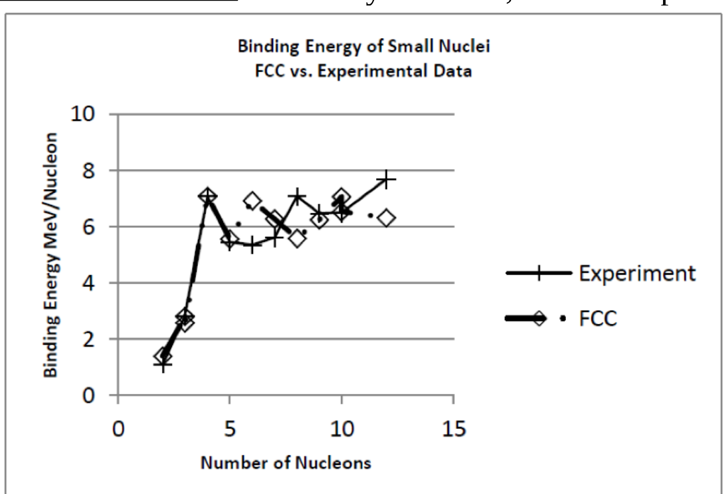


Chart 3. FCC model v. Experimental data on Binding Energy.

We would be remiss if we did not mention the most commonly accepted model of the nucleus. Mainstream nuclear theory *is* the Independent Particle Model, developed in the 1940's and formalized by Meyer & Jensen. It attempts to explain the data by trying to explain the peaks. According to IPM these arise from the nucleons filling shells within the nucleus, similar to the filling of quantum shells by electrons. The Independent Particle Model can say nothing quantitative about Binding Energy, so it is not very useful for explaining the data.

The New Physics on the other hand provides a novel, accurate explanation for the Binding Energy data, as shown in Chart 4.

TNP is accurate to 1.43% and has correlation to the curve shape of 0.9989.

This incredible level of agreement with the known measurement data is unprecedented. How was this achieved?

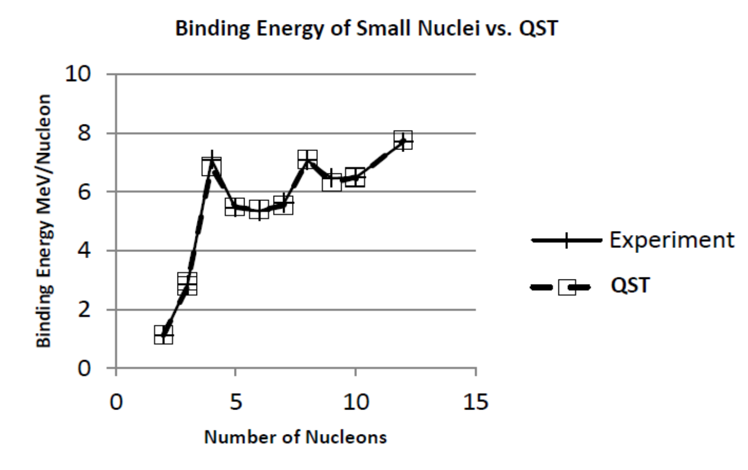


Chart 4. QST model v. Experimental data on Binding Energy.

Model	Average Absolute Error	Correlation Coefficient
Quantum Spring Theory	1.430%	0.99893
Face-Centered Cubic	10.950%	0.91500
Liquid Drop	55.918%	0.98057

Table 1. Comparison of QST to alternative models of nuclear Binding Energy (also called Mass Defect.)

Actually, we had started out on a different path altogether back in 1977, trying to understand how gravitation results from the creation of particles like protons and neutrons—the basic particles in the nucleus of every atom[2].

Starting with the insights provided by that effort and assembling a dozen facts known about protons and neutrons, we used those facts to deduce a model of the particle structure. No other theory has ever tried to suggest the internal structure of these particles. But without a model of them, it is simply not possible to understand the fusion energy released when these particles combine. This is the great leap in our research. It is this structure that is in a very real sense the "double-helix" of Cold Fusion. (For the sake of accuracy, we should mention it is really a *truncated icosahedron*, not a double-helix.)

It is fair to ask if there is any evidence (beyond the ability to explain the fusion data so well) that this rather surprising set of notions is valid.

SIZE OF THE HYDROGEN NUCLEUS

The only particle in the ^{1}H nucleus is a proton. One might naturally expect the measurement of the nuclear radius to equal the radius of the proton. Measurement of the radius of the ^{1}H nucleus is performed by electron scattering, with results similar to Figure 1, adapted from the HyperPhysics topic[4]. Figure 1 illustrates two unique features: (1) the radius is scattering is larger than the radius of the proton, and (2) the radius is not a well-defined edge but rather a range of values is detected. The previously suggested explanation for these observations is that the "charge density" of the proton extends beyond its physical radius. This answer is somewhat unsatisfying: a positive charge should attract an electron, not repel it. The NP model of the proton provides a much more convincing explanation for the observations.

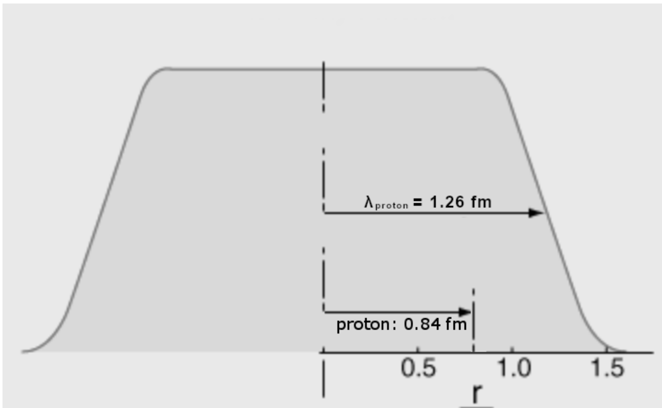


Figure 1. Electron scattering results of measuring the size of the ^{1}H nucleus.

Figure 2 shows The NP model of a proton[3]. The first nuclear quantum layer is shown surrounding the proton. It is a layer of space compressed to a greater permittivity and permeability than space far from particles. Its radius is the measured radius of the ^{1}H nucleus. Notice it provides a range on the nuclear edge; depending on the precise trajectory of the incoming electron, it is penetrated to a greater or lesser extent.

The phenomenon that nuclei are larger than the particles they contain is called the "nuclear skin" by Cook[3]; all nuclei have such a nuclear skin. The nuclear skin was discovered to exist long before TNP emerged; it has never, until now, had any explanation beyond the observation that it is present.

As shown in Figures 1 & 2, TNP points out the radius of the first nuclear quantum level is also the wavelength of the proton. According to TNP, the particle and the wave always both coexist, quite a different hypothesis to that of the Copenhagen Interpretation of Quantum Mechanics and its puzzling offspring, the multiverse. (TNP should possibly embrace the multiverse model: it improves the chance that there is a universe where no one believes in the multiverse so TNP would thrive there; in all seriousness there have been interpretations of Quantum Mechanics compatible with The NP model, they just have not been widely accepted.)

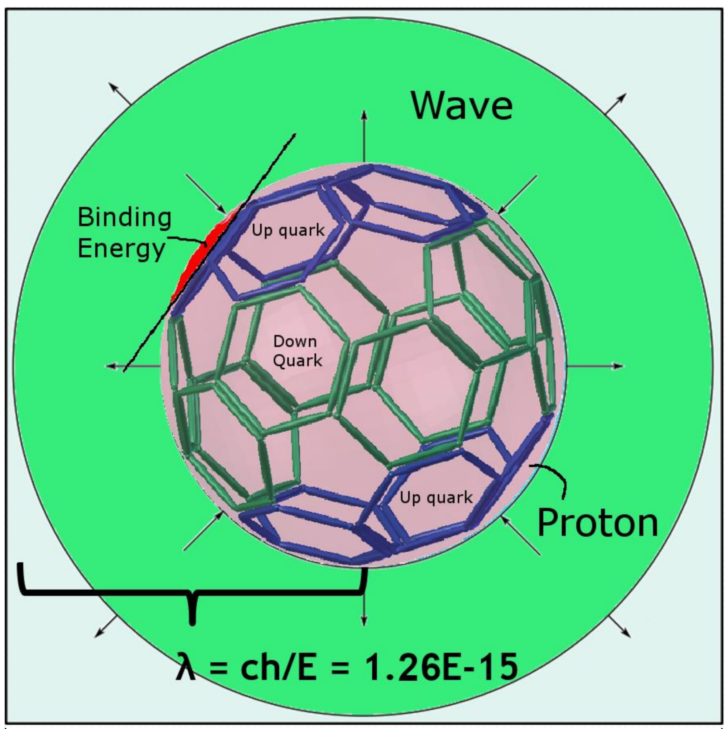


Figure 2. QST model of a proton showing 1 down quark, 2 up quarks, the first nuclear quantum layer with radius the wavelength, and a hexagonal spherical cap yielding the binding energy (mass defect.)

Figure 2 also illustrates the physical origin of the binding energy of nuclear fusion. The suggested model has two types of spherical caps: hexagonal and pentagonal, which differ in volume. In Figure 2 the binding energy (or equivalently by $E = mc^2$ the mass defect) is illustrated as the amount of energy it took to create a spherical cap. The energy required to create a proton is known, and the energy to create the quarks is known approximately, so it is possible to determine with precision the energy it takes to create the mass in each type of spherical cap. Once this is done, construction of a nucleus can be made by deciding which spherical caps are lost when the particles fuse (illustrated for the Deuterium nucleus in Figure 3.)

It is worth pointing out the radical departure from historical models implied by the accuracy attained with The NP model. In conventional physics, the strong force both holds quarks of opposing charge together in the nucleus and holds particles such as protons and neutrons together in the nucleus (both are positively charged at their boundaries.) In The NP model, the strong force is simply the inverse of the pressure exerted by the bubble on space; it is space itself that is pushing in holding the quarks together. This the origin of the spring concept in The New Physics: the creation of the particle makes a bubble in space, like cocking a spring, and space pushes back on the particle, holding its components in place.

It is best in this context to think of space as being a particularly stiff material. If a low-energy bubble like a light photon or a neutrino is formed, once created it exists it travels at the speed of light until the energy that created it is released (for example in the act of raising an electron to a higher quantum level of its atom.) If a heavier particle like an electron or a proton is formed, then a quark structure is required to brace the bubble open. Such particles cannot travel at light speed, for reasons we will explain a bit later on. The strong force is just the inverse of the creation force that formed the bubble; the opposite force in reaction to the force of creation.

According to TNP the positive particles in the nucleus are held together not by the strong force but by the mass defect: to separate the particles, energy equivalent to the mass defect must be re-supplied. This is a lot more energy than required to overcome the Coulomb forces of the particles.

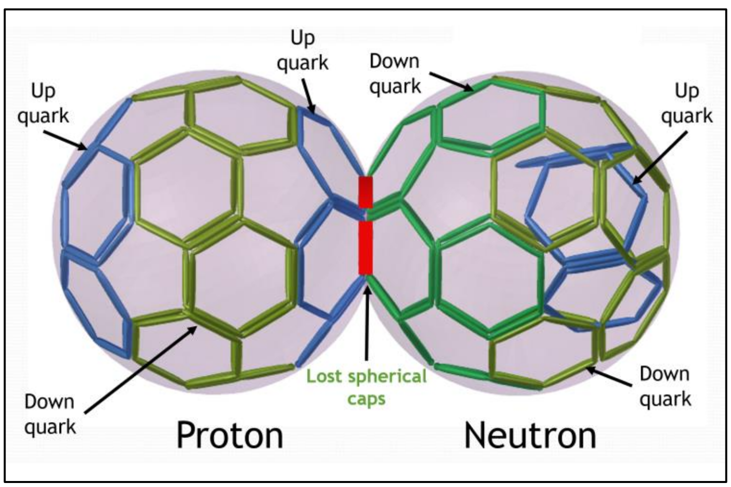


Figure 3. Deuterium, ^{2}H. A proton (left) and a neutron (right) showing the location of the lost spherical caps (mass defect) in red.

Even more important than the relevance of the model to our understanding of how fusion works is the hypothesis that classical mechanics *does* operate at subatomic scale. If correct, the importance of the realization that classical physics applies at subatomic scale cannot be overestimated. It removes the need for a theory of nuclear interaction which is independent of the rest of physics, laying the foundation for a unification of physics not previously possible. Suddenly a number of previously mysterious phenomena are revealed as sensible consequences of classical physics.

OTHER NUCLEI

Thus far we have shown a model for Deuterium which supports Chart 4. We would like to illustrate the models used to build out the rest of the Chart. To describe the bonds between the particles, it will help to have a way to refer to specific Pentagonal Caps (PentaCaps) and Hexagonal Caps (HexaCaps). This is to enable the work to be reproduced and refined.

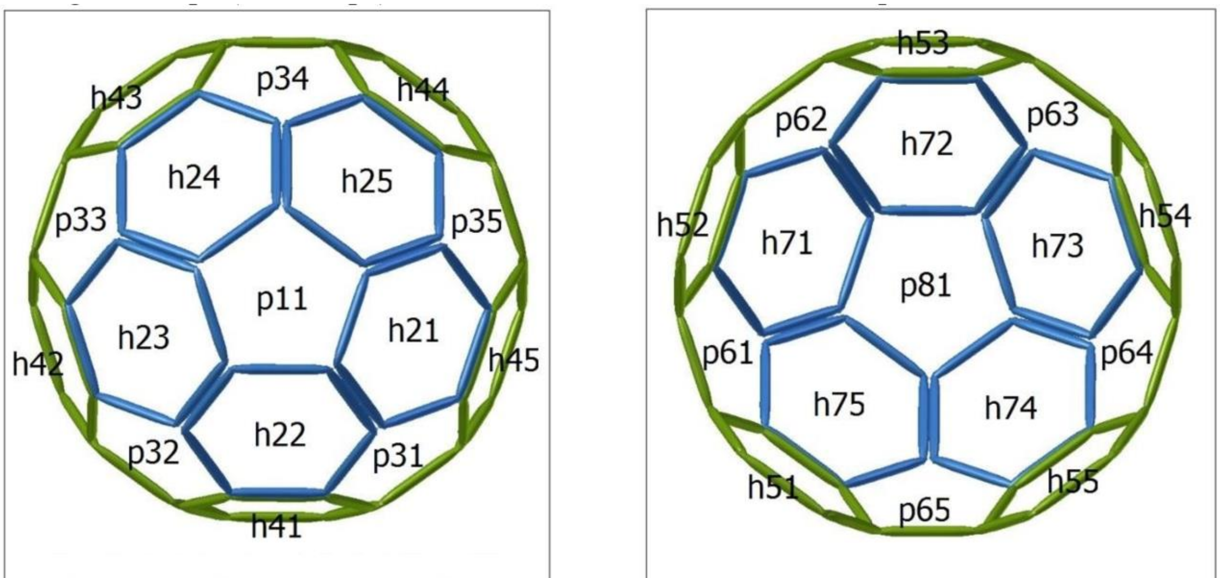


Figure 4. A numbering scheme for labeling spherical caps. These aid identifying which caps have been used in the construction of a given nucleus.

Figure 4 (left) shows a way to label the caps looking at the "front" of the proton. The first numeral is the level of the cap, starting at level 1. The second numeral is the number of the cap on that level, starting at 1. As it happens each level only has caps of one type: PentaCaps or HexaCaps. The front of the particle with p11 in the centre (and closest to the reader) is chosen as the darker side on the neutron, and as the side where the initial bond is made on the proton. The first bond is arbitrarily chosen to be on the lowest numbered cap that matches the geometry of the nucleus. Figure 4 (right) shows the back of the proton but looking at it from the front, with the front half of the quark structure cut away so the rear caps are visible. The cap p81 is furthest from the reader. The numbering scheme can be seen to extend smoothly from the front onto the back side with h51 on the back adjacent to h41 on the front.

We can label neutron caps the same way because in this model, the two down quarks of the neutron have the same geometry as the two up quarks plus the down quark of the proton.

In addition to this convention we will call the first proton added to the nucleus P1 and the first neutron N1.

Let's look in more detail at deuterium (Figure 5) we see a bond of P1p11-N1p11.

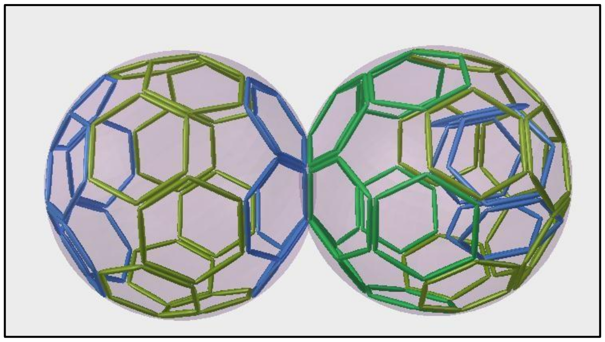


Figure 5. In the deuterium nucleus the up quark is pinned to the side of the neutron opposite the bond to the proton. Note the pentagonal spherical cap cut from each particle at the bond: the binding energy or mass defect. Details:
^{2}H: PentaCaps: 2
Bonds: P1p11-N1p11
Coulomb: -1.01600E-15 Nm
Tesla: 4.42592E-15 Nm
Binding Energy Model: 3.56419E-13 Nm
Binding Energy Data: 3.56419E-13 Nm
Error: 0.00% (calibrated)

Figure 6 shows a spring theory model of ^{3}H. In the notes to the figures Coulomb stands for electrostatic energy and Tesla stands for magnetostatic energy.

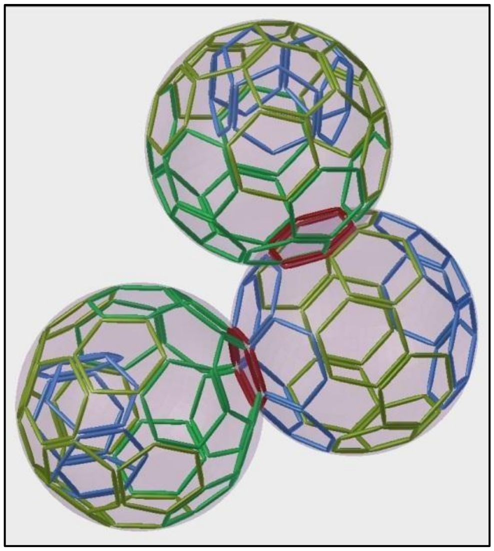


Figure 6. ^{3}H: PentaCaps: 2, HexaCaps: 2
Bonds: P1p11-N1p11 & P1h41-N2h21
Coulomb: -2.35659E-15 Nm
Tesla: 7.20862E-15 Nm
Binding Energy Model: 1.33305E-12 Nm
Binding Energy Data: 1.35897E-12 Nm
Error: -1.91%

Figure 7 illustrates 3He with the unusual case where we must have two HexaCaps broken in a single bond in order for the model to have decent accuracy to measurement. The proton P2's PentaCap in the same bond seems to have room to remain intact if the proton is rotated so that the pentagonal centre line of P2 is aligned with the pentagonal vertex on N1. This model has a larger maximum span than 3H, which corresponds to its larger measured size.

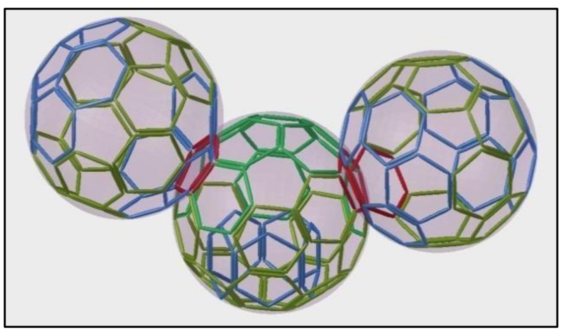


Figure 7. ^{3}He: PentaCaps: 3, HexaCaps: 2
Bonds: P1p11-N1p11 &N1p34-P2h21h45
Coulomb: -9.54685E-14 Nm
Tesla: -1.00028E-15 Nm
Binding Energy Model: 1.40824E-12 Nm
Binding Energy Data: 1.35894E-12 Nm
Error: 3.63%

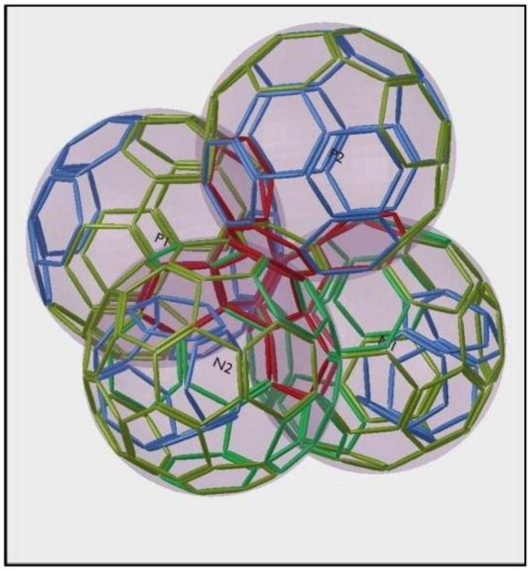


Figure 8. ^{4}He: PentaCaps: 9, HexaCaps: 6
Bonds: P1p11-N1p11 &N1p34-P2h21h45
Coulomb: -1.45992E-13 Nm
Tesla: 8.37836E-15 Nm
Binding Energy Model: 4.37650E-12 Nm
Binding Energy Data: 4.53352E-12 Nm
Error: -3.46%

The alpha particle holds a special place in nuclear structure theory. Alpha radiation is one of the primary forms of radiation which occurs when—according to spring theory—the strong force of the compressive space surrounding the nucleus can no longer hold the nucleus together. The fact that the alpha particle seems to be bound together as a unit more tightly than other combinations of particles is also reflected in the branch of nuclear structure theory that surmises that atomic nuclei are constructed of clumps of alpha particles [1]. Our findings place us firmly in this camp.

All this circumstantial evidence is supported by our model of ^{4}He which has a large number of busted caps. To make the structure clearer we include Figure 9 showing only three of the particles.

In Figure 9 you can see that three HexaCaps are broken by their proximity in the centre of the cluster of the three particles. Their spherical caps interfere with each other, so they flatten when the particles bond. A fourth HexaCap that belongs to P2 sits on top of them and does not break because once these are flattened, there is room for the fourth cap. You can also see the three PentaCaps that P2 will bond with. P2 has three HexaCaps at the right locations to bond with these three PentaCaps, which may now be clearer if you reconsider Figure 9.

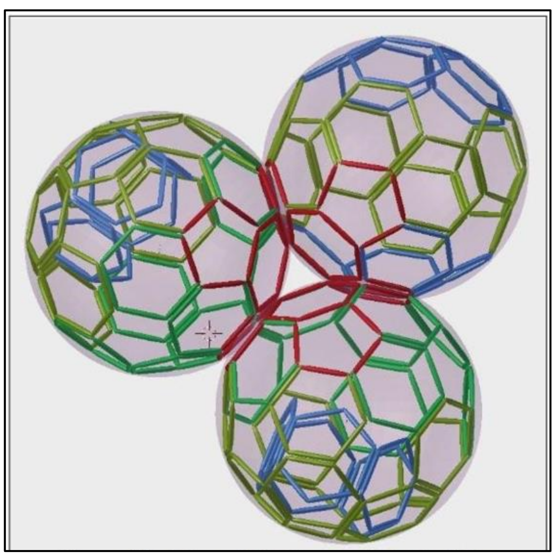


Figure 9. ^{4}He showing P1, N1 and N2, with P2 hidden from view. Note the slightly imperfect fit of the PentaCaps to each other. Does this mean there is a better alternative bracing structure than the truncated icosahedron? Or is some gap required by thermal motion of the nucleons? Or is there some other explanation? We don't have enough data to be sure.

A number of factors influence how we construct these models. We look at all the various combinations of HexaCaps and PentaCaps and discover those that yield matches to the data. Then we consider more closely those that are feasible to build. As a general principle we assume that nature will strive for a spherical configuration. In TNP this is encouraged by the nuclear skin or "quantum level 0" as we call it. The nuclear skin is a layer around the nucleus of increased density [3, p135]. Spring theory explains this as the compressed space within a quantum level 0 that immediately surrounds the particles injected into space [1]. Its thickness is generally about 2.3 to 2.4 fm but its shape is less well understood. We assume the nuclear skin will at least tend to be spherical if not actually attaining a spherical shape. It is not always possible to construct a sphere whilst breaking a number of PentaCaps and HexaCaps that yield a match to the data.

In addition calculations of the repulsive electrostatic forces show that protons repel protons with greater force than they do neutrons. The dual PentaCap proton-proton coulomb energy is -1.20764E-13 Nm whilst the proton-neutron energy is −1.01600-15 Nm, with the negative signs indicating repulsion. This is a difference of more than a factor of 100, which we think will incline protons to bond to neutrons before protons, all other things being equal. Using the same logic the neutron-neutron dual PentaCap repulsion is another factor of 10 weaker at −1.02557E-16 Nm, so a neutron is more likely to bond with a neutron than with a proton. Note that for HexaCap bonds the numbers are higher because there is less distance between centres. Magnetic effects are more difficult to understand. We use Eq. (15) to compute the final binding energy, but are less certain how influential magnetic effects might be in determining the shape of the nucleus, and how they combine as nucleons are added, considering these an important areas for further investigation.

Does the bond between up and down quark structures have attraction? Are down quark bonds repulsive? Do particular caps have affinity for others? We don't have enough data to answer these questions yet.

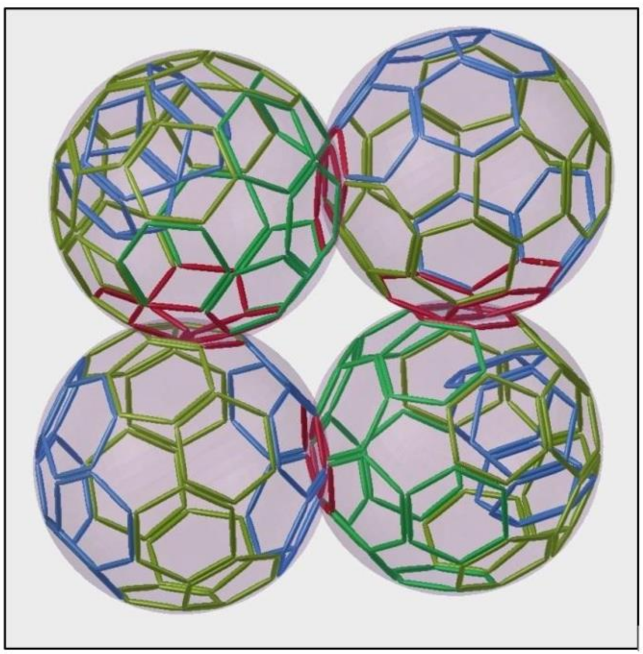


Figure 10. ^{4}He planar. PentaCaps: 6, HexaCaps: 7
Bonds: P1p11-N1p11 & N2h21h45p31p35-P1h45 &
N2h24-P2p64 & N1h53-P2p11h21h22
Coulomb: -1.23447E-13 Nm
Tesla: 1.23919E-14 Nm
Binding Energy Model: 4.47144E-12 Nm
Binding Energy Data: 4.53352E-12 Nm
Error: -1.37%

An alternative, magnetically stable version of 4He is shown in Figure 10. We worked with this version for quite some time before returning to the tetrahedral shape. Despite the fact that this version has larger net magnetically attractive energy, we were bothered by three issues with this model: (1) the model did not extend very well for 12C; (2) the way that so many caps were involved in two of the bonds, with the precise number seeming to require very precise contortions to achieve; and (3) the way the 2-cap bonds had to be skewed so that the caps did not meet aligned. These are subjective reasons at best, and we do not really know whether this or the tetrahedral—if indeed either—is the best fit to reality. More data on the shape and size of the nuclei, along with more work to correlate the magnetic dipole and electric moments of these models with real data are required to resolve the issue. We included this alternative structure for 4He to give the reader a more complete picture of the status of this research. Although we are pleased with overall progress and believe we are on the right track, we do not want to give the impression that we have resolved all the open issues.

Next is Figure 11 of ^{5}He. It has the same number of bonds as ^{4}He: the third neutron is just resting against the other particles. It is not hard to understand this is not a stable isotope.

In ^{6}Li N3 bonds to P1 with two PentaCaps and P3 bonds to N3 with a PentaCap-HexaCap bond.

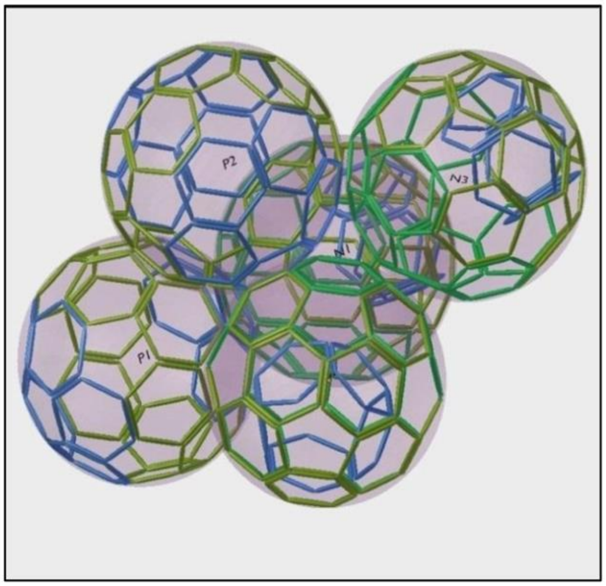


Figure 11. 5He: PentaCaps: 9, HexaCaps: 6
Bonds: Same as 4He.
Coulomb: -1.49575E-13 Nm
Tesla: 1.39438E-14 Nm
Binding Energy Model: 4.37849E-12 Nm
Binding Energy Data: 4.36449E-12 Nm
Error: 0.32%

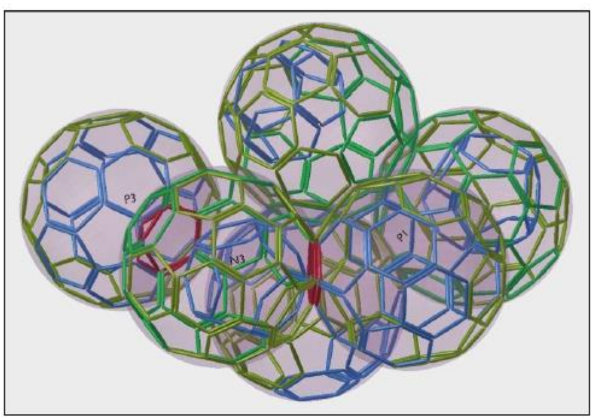


Figure 12. 6Li: PentaCaps: 12, HexaCaps: 7
Bonds: Same as 4He & P1p32-N3p31 & N3p81-P3h21
Coulomb: -3.73600E-13 Nm
Tesla: 5.73487E-15 Nm
Binding Energy Model: 5.16336E-12 Nm
Binding Energy Data: 5.12601E-12 Nm
Error: 0.73%

In ^{7}Li we show N3 HexaCap bonds to N1, P3 PentaCap bonds to N2, and N4 having PentaCap bonds with both N2 and P3.

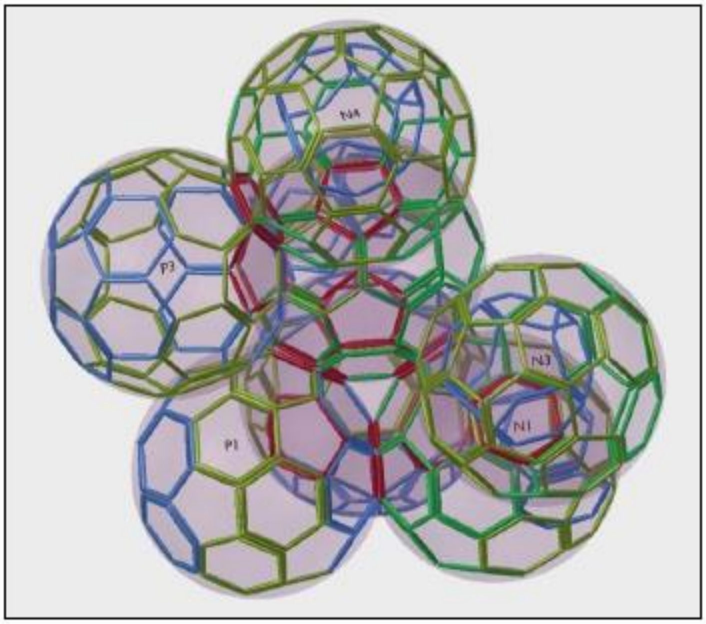


Figure 13. ^{7}Li: PentaCaps: 15, HexaCaps: 8
Bonds: Same as 4He & N3h21-N1h53 & P3p11-N2p61 & N4p11-P3p31 & N4p11-N2p62
Coulomb: -3.59934E-13 Nm
Tesla: 8.51757E-15 Nm
Binding Energy Model: 6.19692E-12 Nm
Binding Energy Data: 6.28438E-12 Nm
Error: -1.39%

^{8}Be is our first cluster of alpha particles, with N4 of the second alpha particle binding to both N1 and P1 using PentaCaps.

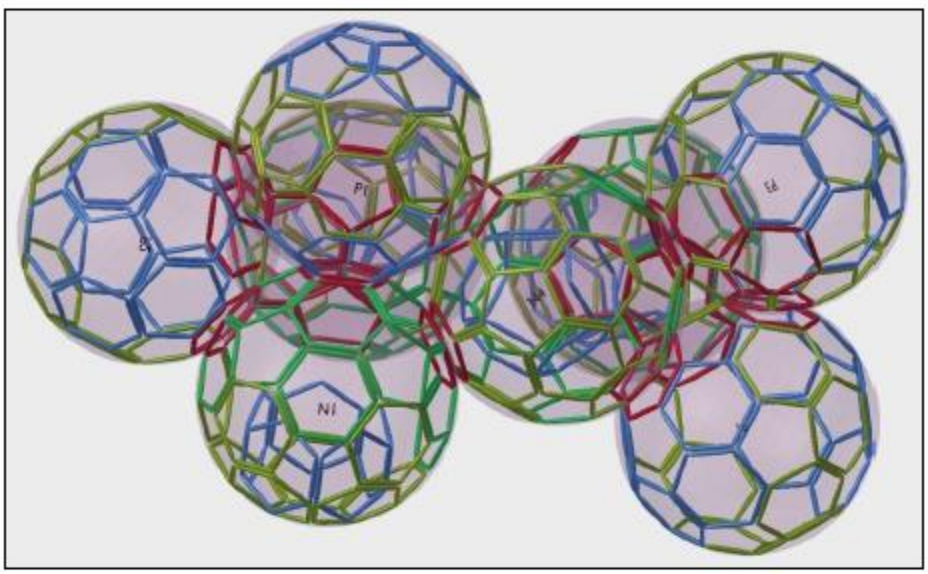
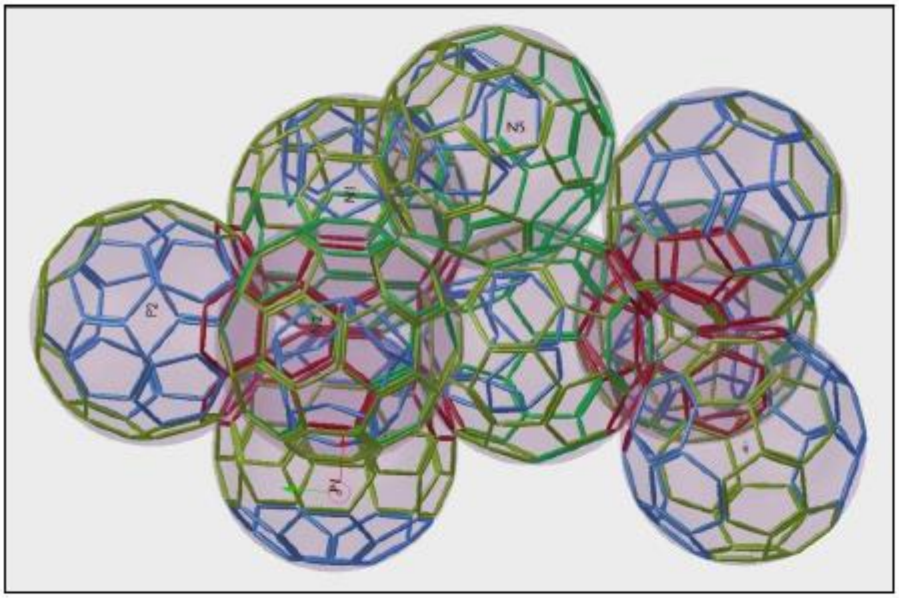


Figure 14↑. ^{8}Be: PentaCaps: 22, HexaCaps: 12
Bonds: Same as two sets of 4He & N4p61-N1p32 & N4p62-P1p32
Coulomb: -6.81418E-13 Nm
Tesla: 2.39653E-14 Nm
Binding Energy Model: 9.07680E-12 Nm
Binding Energy Data: 9.05230E-12 Nm
Error: 0.27%

Figure 15↓. ^{9}Be: PentaCaps: 22, HexaCaps: 12
Bonds: Same as 8Be
Coulomb: -6.81418E-13 Nm
Tesla: 2.39653E-14 Nm
Binding Energy Model: 9.07806E-12 Nm
Binding Energy Data: 9.13906E-12 Nm
Error: -2.59%

Figure 15 shows ^{9}Be is just like ^{8}Be but with an extra neutron N5 resting on the surface, unbounded. This is another unstable isotope.



In Figures 16 and 17 we show N5 bonded to the alpha cluster via P3 using 2 HexaCaps. In Figure 16 N5 bonds to N6 with PentaCaps. In Figure 17 P5 bonds to N5 using a PentaCap-HexaCap bond.

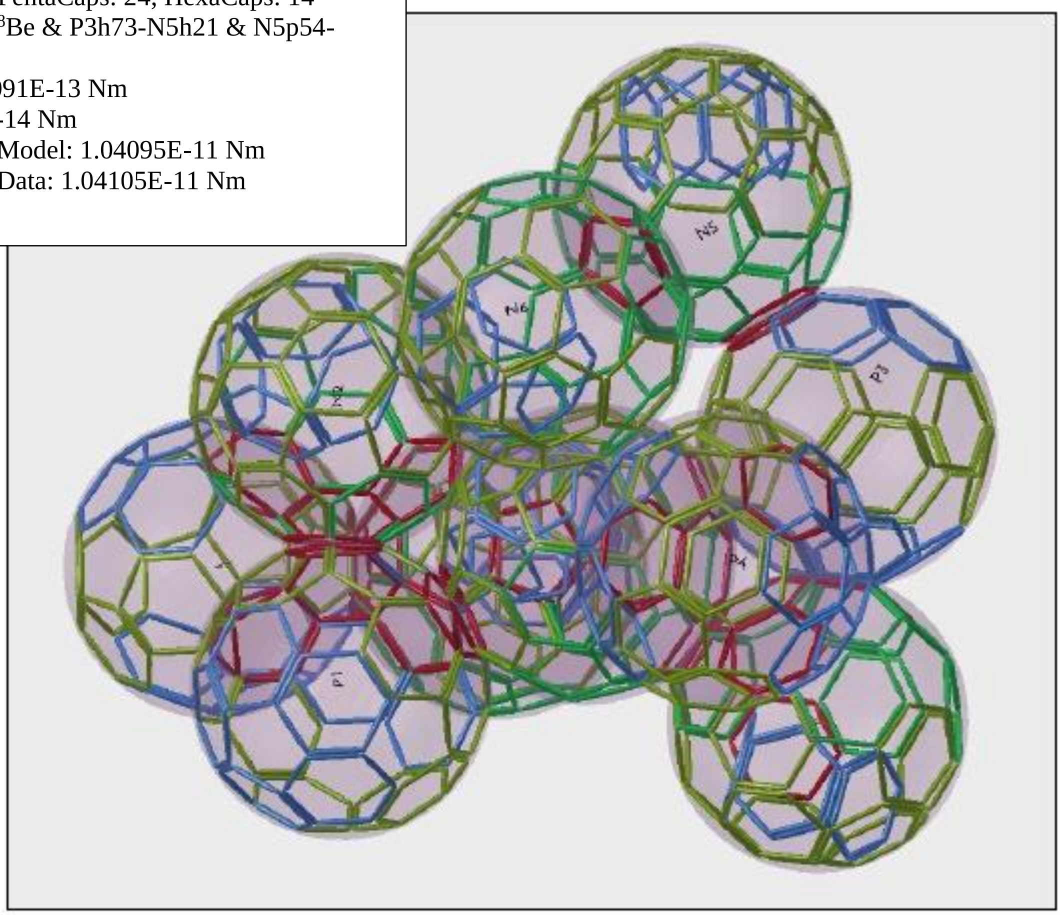


Figure 16. ^{10}Be: PentaCaps: 24, HexaCaps: 14
Bonds: Same as ^{8}Be & P3h73-N5h21 & N5p54-N6p11
Coulomb: -6.88091E-13 Nm
Tesla: 3.50962E-14 Nm
Binding Energy Model: 1.04095E-11 Nm
Binding Energy Data: 1.04105E-11 Nm
Error: -0.01%

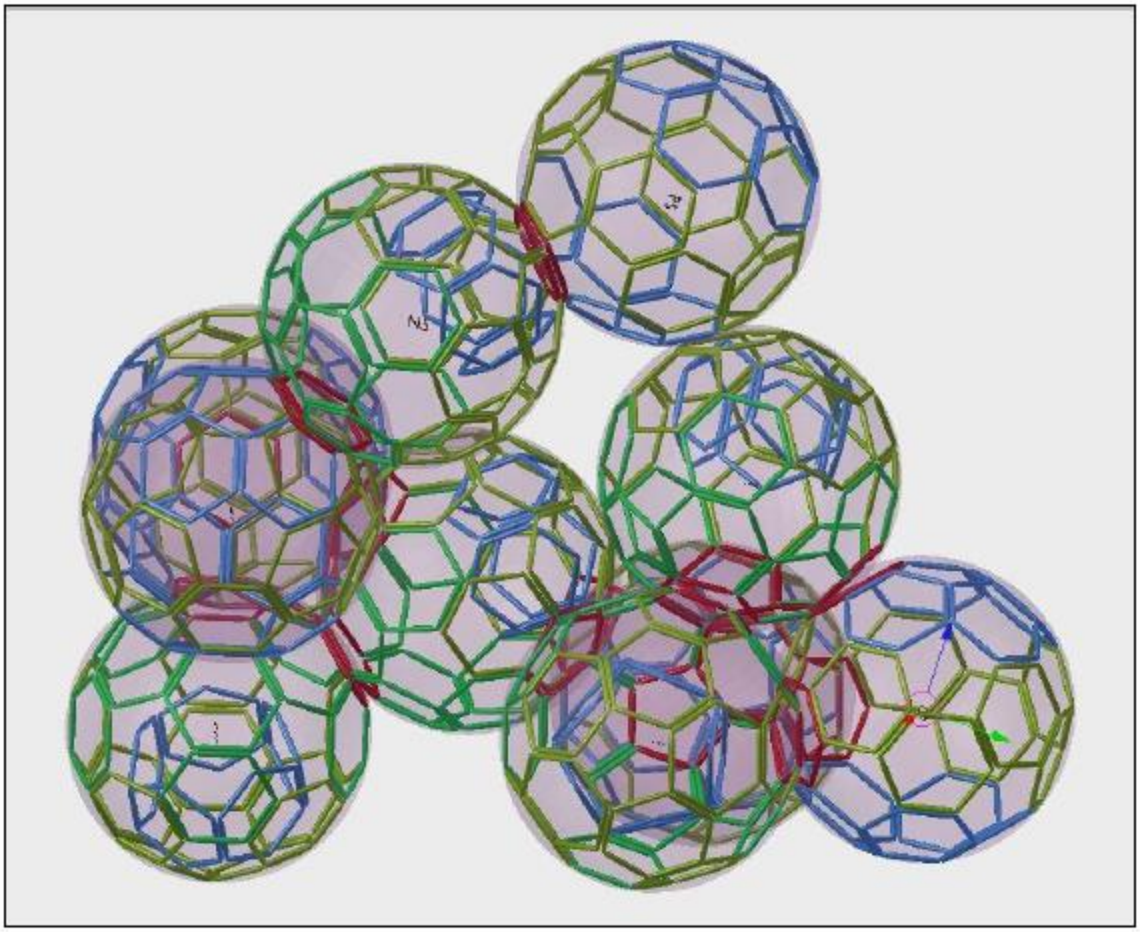


Figure 17. ^{10}B: PentaCaps: 23, HexaCaps: 15
Bonds: Same as 8Be & P3h73-N5h21 & N5p81-P5h21
Coulomb: -1.09787E-12 Nm
Tesla: 2.68873E-14 Nm
Binding Energy Model: 1.03026E-11 Nm
Binding Energy Data: 1.03743E-11 Nm
Error: -0.69%

Figure 24 illustrates ^{12}C. This is a cluster of three alpha particles with the third bonded with HexaCaps to both of the other alpha particles. Note the rough fit of these bonds between N5 and N3/N2. There may be another geometry that makes the fit more precise, but we have not discovered it yet.

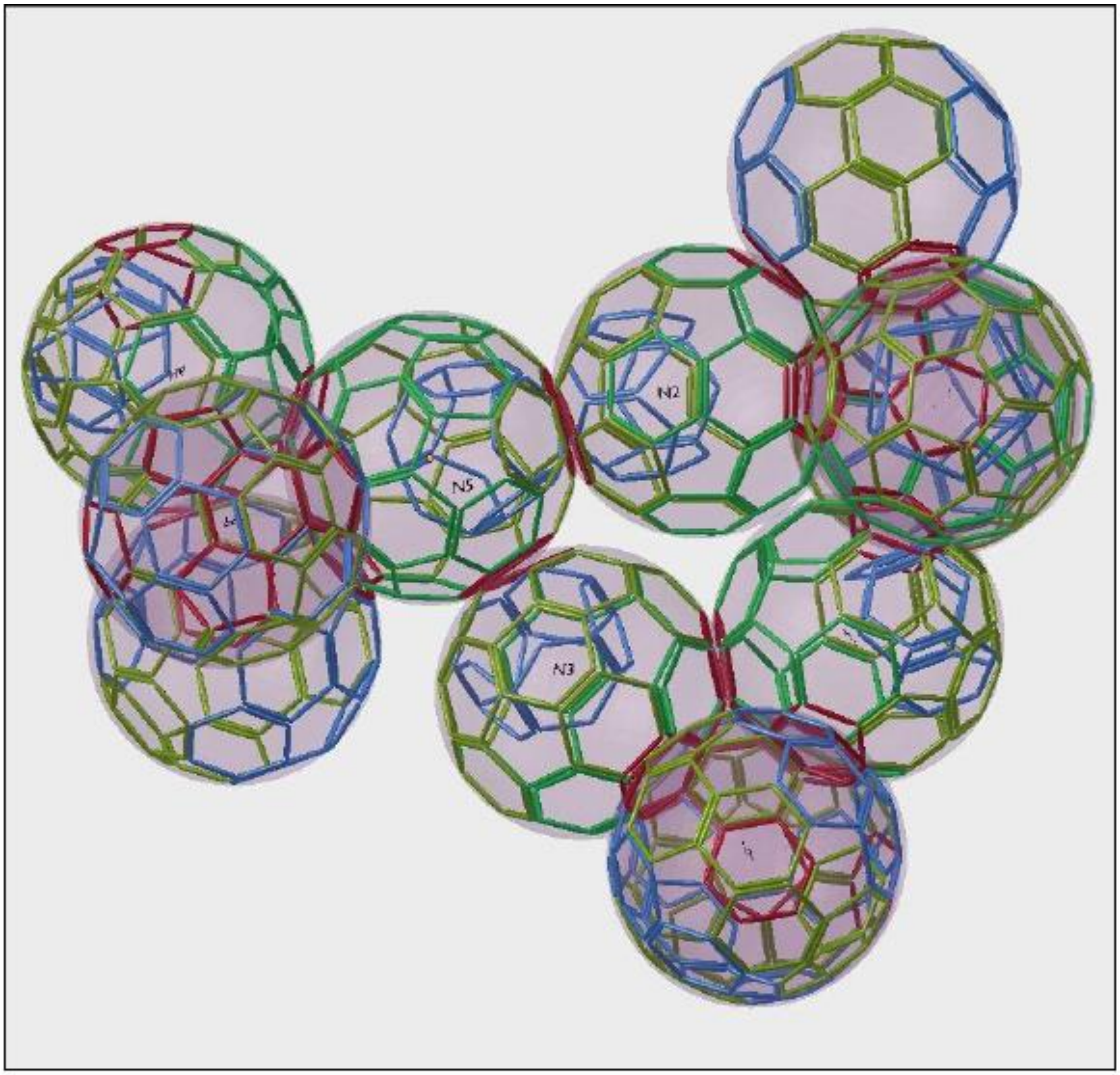


Figure 18. ^{12}C: PentaCaps: 31, HexaCaps: 22
Bonds: Same as 8Be & N5h71-N2h71 N5h74-N3h72
Coulomb: -1.37286E-12 Nm
Tesla: 4.79307E-14 Nm
Binding Energy Model: 1.48738E-11 Nm
Binding Energy Data: 1.47660 E-11 Nm
Error: 0.73%

RELATIVISTIC MASS

In addition to the conclusion that classical mechanics applies at subatomic scale, a subtler implication stems from the hypothesis at the foundation of The New Physics. This is the strictly geometric nature of gravitation. This follows from the mathematical derivations which show the force of gravity depends only on geometric quantities[1]. We have found some circumstantial evidence that this is correct, and it leads to an understanding of why there are two types of particles: those that can travel at the speed of light (photons) and those that cannot (protons, neutrons), even though they are both created in the same way: by delivering the required amount of energy to a small volume of space.

Figure 19 shows the mass, measured at the first quantum level, of a particle moving at increasing velocities, approaching on the right-hand side the speed of light. The formula is from Einstein's Special Relativity.

The reasoning behind Special Relativity is very compelling. Einstein makes it clear that if light is to always travel at the same speed in a vacuum, then it is absolutely necessary that lengths will contract and time will slow down relative to a non-moving frame of reference. It is less clear, however, why an object should gain mass. After all, if one dimension is shrinking, and the others remain constant, isn't it more reasonable that the (now smaller) oject would have less mass, not more?

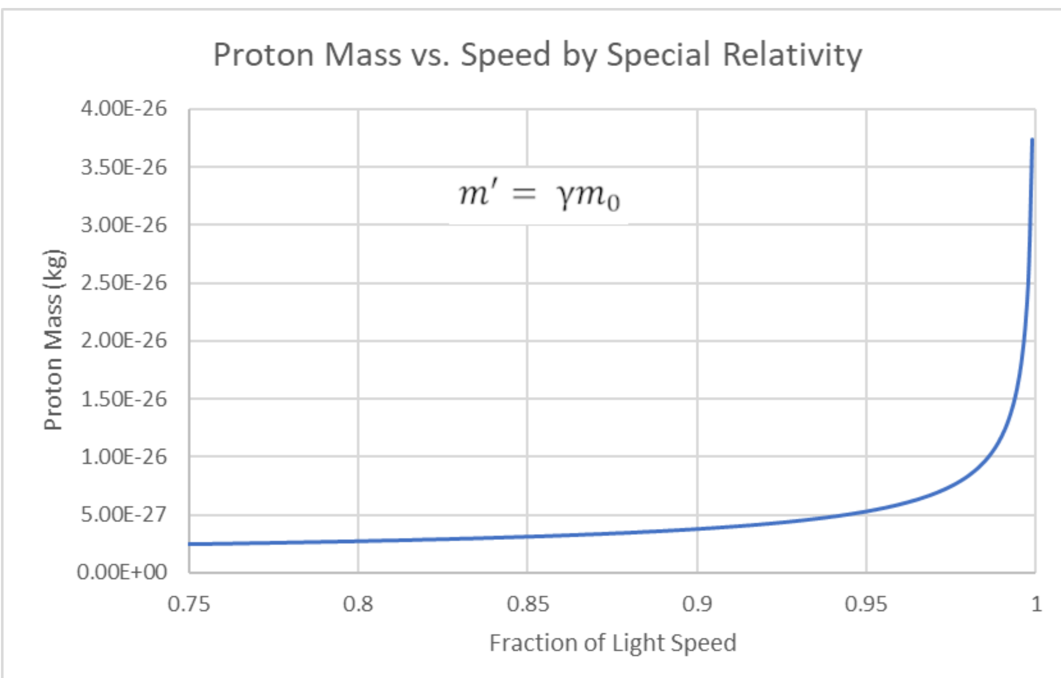


Figure 19. Mass of a proton as the atom approaches the speed of light according to the Special Relativity model.

The geometric interpretation of mass of TNP solves this puzzle rather elegantly. In Figure 20, we see that an object which is a sphere, when moving near the speed of light becomes an oblate spheroid. This is because of the contraction of length along the direction of travel.

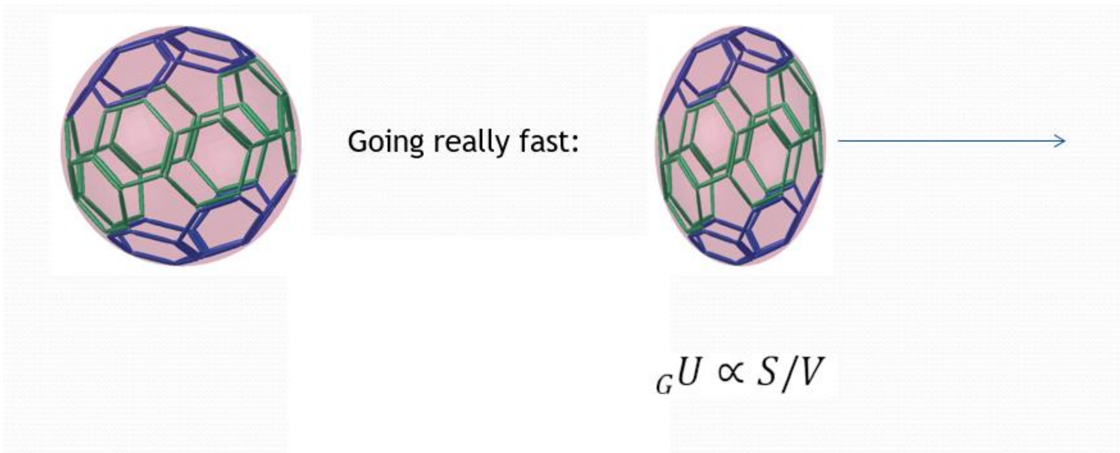


Figure 20. What happens geometrically when a particle goes near the speed of light. Length contraction causes the surface area to shrink towards the surface area of two disks, but the volume shrinks even faster towards 0. The formula expresses the acceleration of gravity as a function the surface area divided by the volume of the particle. See reference[1] for details.

The formulas in Figure 20 are derived in [1]. The strong force is related directly to the amount of energy it takes to create the particle, or equivalently, its mass. Notice what happens to this when the particle approaches the speed of light (Figure 21.)

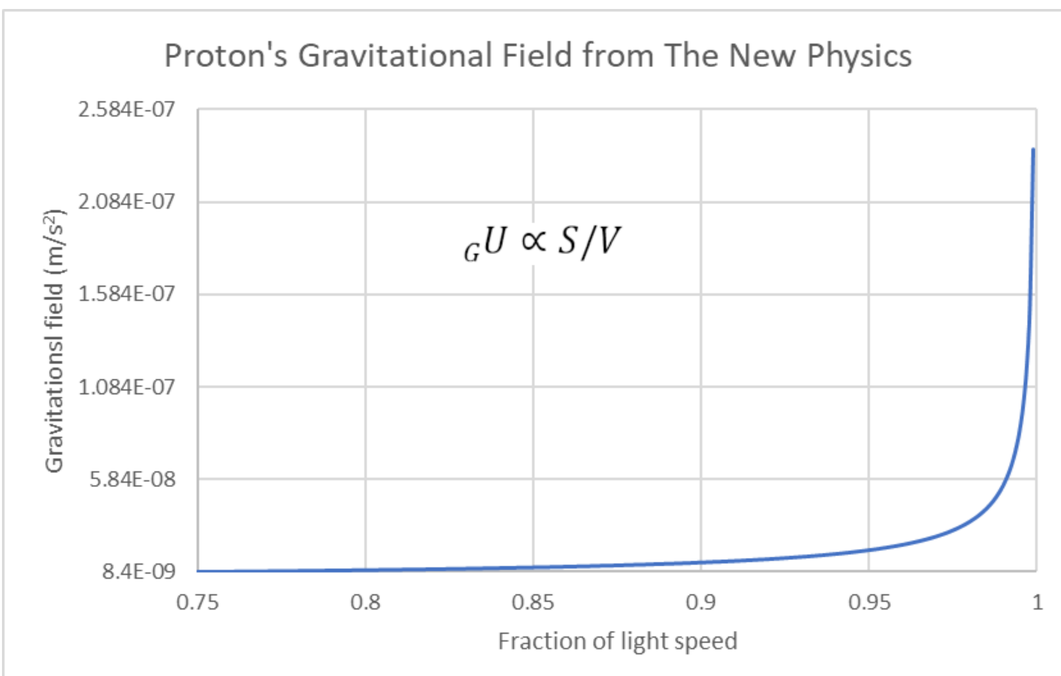


Figure 21. What happens to the proton's gravitational field when it approaches the speed of light. The result differs from Figure 19 by a nearly constant factor.

We see that Figures 19 and 21 are a similar curve. The ratio of the corresponding points in both curves is almost constant, despite the stark difference in the formulas to compute each of them. But Figure 21 has a geometric interpretation that makes sense. Due to relativistic length contraction in the direction of travel of the bracing quarks, the volume shrinks to zero so gravitational acceleration (i.e., the effect of its mass) approaches infinity.

According to The NP model, both light photons and fundamental particles are created the same way, but particles like protons have an internal quark structure that carry the elements of the particle's charge. This is also true for neutrons: even though the charged internal quarks have net zero charge, they are still present. Photons have no internal charge components, so instead can travel at light speed without bubble distortion. The internal components (e.g., quarks) of particles which do have them must contract in the direction of travel which affects their mass as they approach the speed of light. This is because their volume shrinks faster than their surface area (Figure 20.) As their volume shrinks to zero and their surface area shrinks towards $2\pi r^2$ (with r being their radius perpendicular to the direction of travel) their gravitational field approaches infinity. But those particles such as light photons and neutrinos without such internal structure do not have this impediment. This is why light photons can travel at light speed, but particles carrying internal charge cannot. This resolves a very old, important paradox: how neutrinos—which are known to have mass—can travel at the speed of light.

NUCLEAR QUANTUM LAYERS

We identified the first nuclear quantum layer by looking at the data on the size of the ^{1}H nucleus containing only a proton. According to The NP model, similar to the hydrogen-like atoms' electron quanta, the nuclear quanta extend outwards from the particle infinitely, likely progressing at the speed of light on creation of the particle, producing gravity waves. Evidence supporting this hypothesis comes from an unlikely source.

One of the more puzzling aspects of physics is the diffraction of light from a single edge. Whilst double-slit and single-slit experiments have wave interference models to explain their observations, the model of diffraction from throwing electrons at a single edge emits a diffraction pattern is less convincing; certainly, there is nothing for the electron to interfere with in this case.

In Figure 22 we show the nuclear quantum layers of the edge material and how the electron is bent into the observed diffraction pattern; Figure 23 shows how each diffracted band has a specific width dictated by the width of the quantum layer, which is discussed further in the next section.

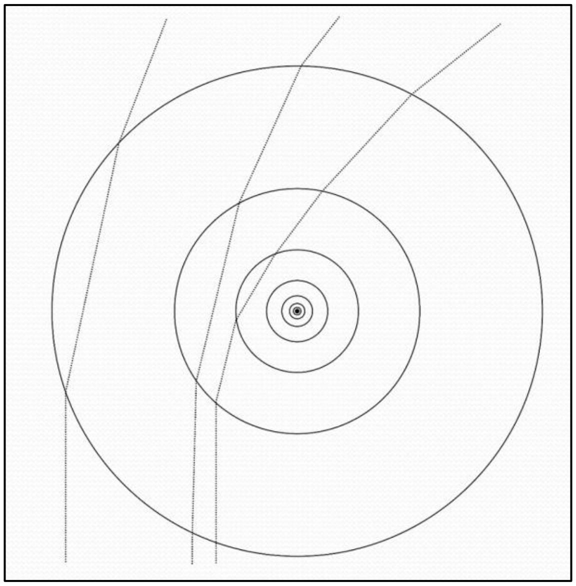


Figure 22. Nuclear quantum layers at the edge showing how incoming particle-waves are refracted increasingly as the permittivity & permeability of the layers increase closer to the particle.

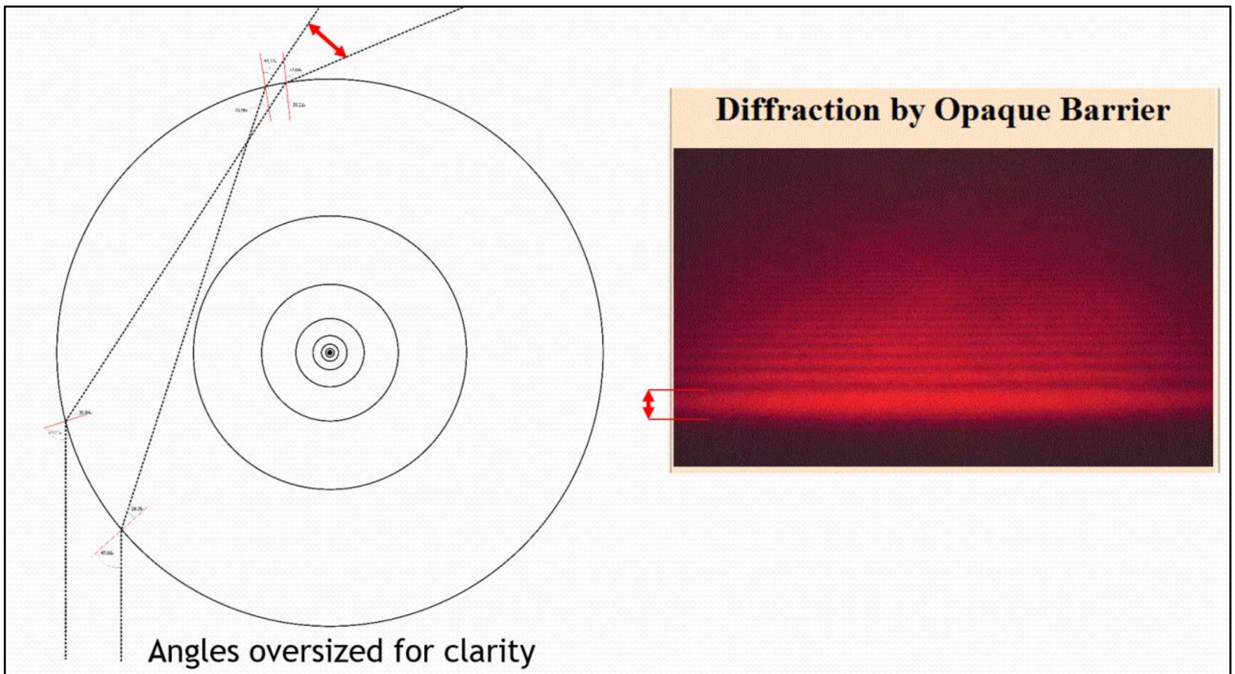


Figure 23. A given nuclear quantum layer will refract incoming particle-waves at slightly different angles depending on where in the layer the incident particle-wave strikes, yielding a spread of each diffraction layer larger than the gap between them, just as the photo shows.

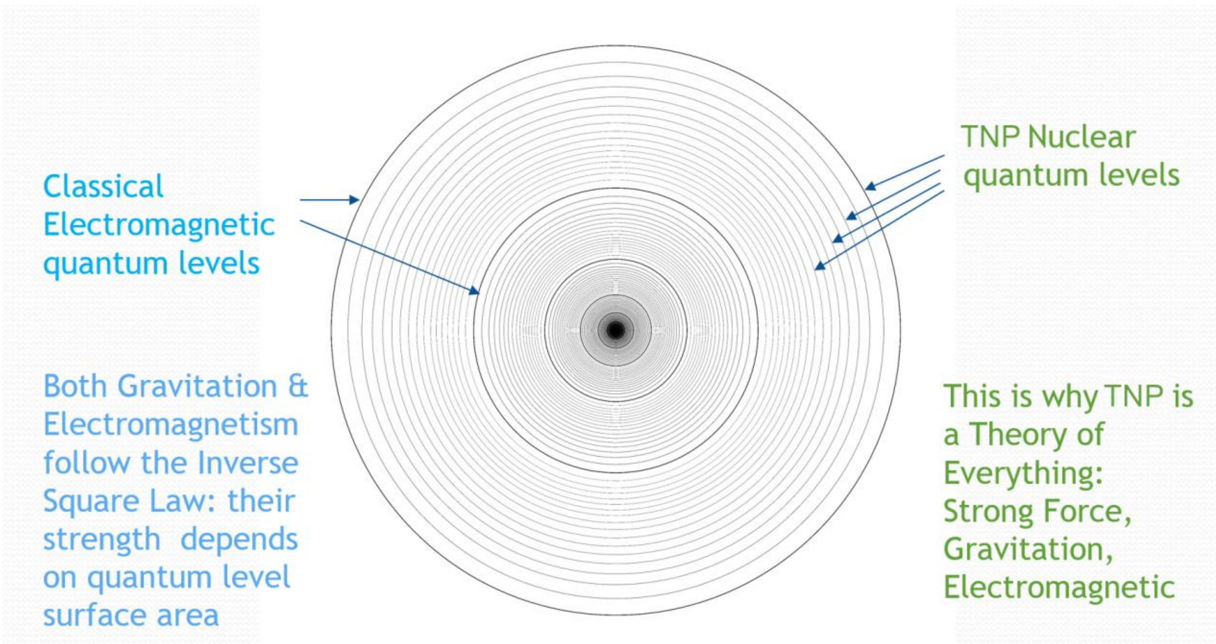
NUCLEAR VS ELECTRON QUANTA

It is natural to ask next whether there is any relationship between the nuclear quantum levels which generate gravitation and the electron quantum layers hosting static electromagnetism.

If we assume that the same relationship for the radius of an electron quantum layer applies to the nuclear quantum layers also, we get (at least numerically within 0.12%, for ^{1}H) the following:

$$r_n = נ_{206n}$$

where *r* is the electron quantum level radius, נ (Hebrew letter nun) is the nuclear quantum level radius, and *n* is the electron quantum level. In other words, $r_1 = נ_{206}$, $r_2 = נ_{412}$, …. This is sketched in Figure 24:



CONCLUSION

The hypotheses and conclusions of The New Physics are difficult to accept at first encounter. Nonetheless the convincing ability of TNP to explain the data on nuclear binding energy, which has lacked an accurate model for over 80 years, compels us to at least consider that there may be some utility to the approach. We have discussed some of the further implications of this line of modelling to illustrate the breadth of issues that can be resolved by adopting, at least for the sake of argument, The NP model. We have also included some information on nuclear structure that was not previously available. Standing alone these additional insights are unlikely to provide the impetus needed for TNP to gain wide acceptance. However, it is our hope that they will encourage others to extend and refine the model, broadening its adoption and utility over time.

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