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An Analysis of Same-Atomic-Weight Isotopes

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An analysis of the precise (NIST) atomic weights of the members of a same atomic weight family of isotopes appears to provide some interesting results. Some important and surprising characteristics of nuclear structure seem to be clear, along with some fine-structure hints. Predictions of the half-life or stability of isotopes seem very reliable. The total amount of released energy in a beta-decay (kinetic and photon) is also generally reliable.

Even more significant is the fact that there seems to be very strong evidence that neutrons do not actually exist as neutrons within atomic nuclei! They certainly exist in free space, but the presentation which follows suggests that they cannot exist within the atomic nucleus. This actually agrees with a long-known fact which seems to have never troubled anyone before. It is universally agreed that the heaviest nuclei are generally all unstable BECAUSE THEY CONTAIN TOO MANY NEUTRONS. However, such a statement seems to imply that a common method of nuclear decay should be the spontaneous natural emission of a neutron, to enable a nucleus to become more stable. But it has long been known that none of the heaviest nuclei ever decay by emitting a neutron! Only three known isotopes decay by emitting a neutron, $^{89}Br_{35}$, $^{87}Br_{35}$, and $^{5}He_{2}$. The first two of these do not naturally occur and are only produced as fission products of $^{235}U_{92}$. If discrete neutrons actually existed within all nuclei, it seems logical that at least some nuclei would naturally decay by releasing one or more of them. Instead, the only time that neutrons are released from any nuclei is as a result of an external disturbance, whether by an external thermal neutron for nuclear fission or incoming radiation.

This presentation uses the abbreviations MeV for million electron-volts and AMU for Atomic Mass Units. One AMU is equal to 931.44 MeV.

We can consider the natural decay of Tritium (Hydrogen-3), with a half-life of 12.33 years, into Helium-3 and an escaping electron (beta particle) (which then becomes re-captured as an orbiting electron). This situation is clearly one where the exact same amount and number of objects are involved. **The difference in the total energy contained in the two nuclei atomic masses should therefore include the 0.782 Mev of binding energy of the neutron inside the Tritium nucleus which is no longer a neutron.** However, using the accepted NIST data for the atomic masses, the difference in the atomic masses is only 0.000020 Atomic Mass Unit (3.0160492675 - 3.0160293097) or 0.0186 MeV. This is therefore the total amount of energy that is available to get released in the decay, in Conserving Energy. Since it is well established experimentally that the escaping electron carries away 0.01859 MeV of kinetic energy, there is no energy produced that even suggests that there had been an initial neutron binding energy of 0.782 MeV. The energy accounting for this decay is especially simple and especially clear at confirming that the disappearance of mass, per the NIST figures, is essentially exactly accounted for by the kinetic energy of the escaping electron. NO possible neutron binding energy could have existed!

There is also less than 10 electron-volts of energy that could account for the neutrino that is also supposed to escape. But the main thing in order for this process to occur, a neutron inside the H-3 nucleus must break apart into a proton, that electron and that (anti-)neutrino. There should have been 0.782 MeV of neutron binding energy that would have to have been released, per the conventional descriptions of nuclear processes.. **These are both logical contradictions of the standard understanding of what occurs and are fully documented.** Even if a neutrino is thought to have a zero rest-mass, SOME amount of energy must originally exist to provide it motion energy. Photons do not have rest-mass, but still there must be some initial energy that then exists as the measurable energy of the photon. With less than 10 electron-Volts available from Tritium decay, it is hard to see how a neutrino could be emitted from that specific beta decay.

These comments summarize some of the seemingly obvious logical contradictions that seem to be the center of all further logic in Nuclear Physics. If they should be incorrect, THAT would represent a big problem!

Now consider two atoms, such as $_{75}Re^{181}$ and $_{76}Os^{181}$. These are isotopes of two different elements, but they each have an atomic weight of 181. They must therefore be very similar. Everyone would agree that they each contain 75 protons inside a nucleus and 75 electrons orbiting around that nucleus. The standard description is that each also contains 105 neutrons inside the nucleus. The second atom has one additional electron orbiting the nucleus and one additional proton inside the nucleus. In their place, the first atom has an additional neutron in its nucleus. But since it is well known that a neutron is unstable, breaking apart into a proton and an electron with a half-life of a few minutes, then it could be said that these two atoms have the exact same constituent parts, as long as that one neutron is identified as a proton plus electron (possibly plus binding energy and a neutrino).

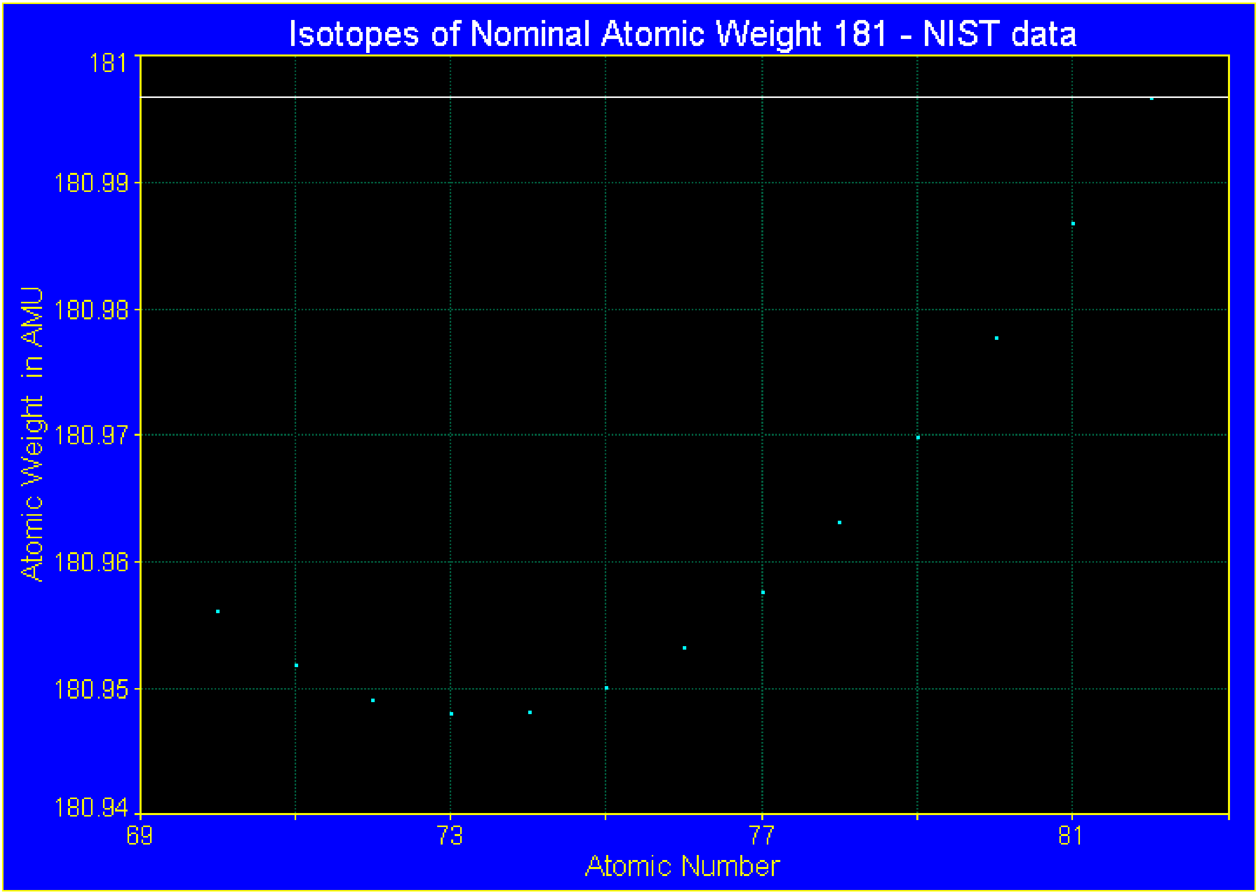
These two atoms have the same nominal atomic weight, but their precise weight is different. For $_{75}Re^{181}$ it is currently known (NIST data) as 180.950065 AMU. For $_{76}Os^{181}$ it is 180.95327 AMU. Since the actual components (considered as protons and electrons) are in the exact same numbers, this difference must therefore be completely due to differences in four things: (1) the binding energy involved in holding each of the atom nuclei together; (2) the binding energies holding the individual neutrons together inside the nucleus, actually the one neutron principle in this discussion; (3) the energy present associated with the neutrinos involved inside the individual neutrons inside the nucleus; and (4) the energy equivalent of whatever pions are present inside the nucleus.

According to standard Physics, then, there are a lot of different binding energies that must be included in this. The primary one, the first one listed above, is usually called the Strong Nuclear Force. It was first proposed in the 1930s, because it was recognized that there is incredibly powerful electrostatic repulsion between the positively charged protons in the nucleus. Left to themselves, those protons would repel each other out of the nucleus in a tiny fraction of a second. Because those protons are so physically close together, their repulsion is clearly (and easily calculated) extremely strong, so they are clearly constantly trying to fly apart, which would cause every atom to decay into some other element. Since many isotopes are stable, the Strong Nuclear Force was postulated (in the 1930s) as the way atoms could be stable. Since the electrostatic repulsion is extremely strong and has an inverse-square dependence on distance, the Strong Nuclear Force was postulated as therefore being an inverse-cubed or higher distance dependence, to be extremely powerful at short distances between protons but to not have any measurable effect beyond the nucleus. In my education at the University of Chicago, I was taught that it was an inverse-fifth-power dependence, although there seems no actual evidence to support such a specific claim, and such claims seem rarely made any more.

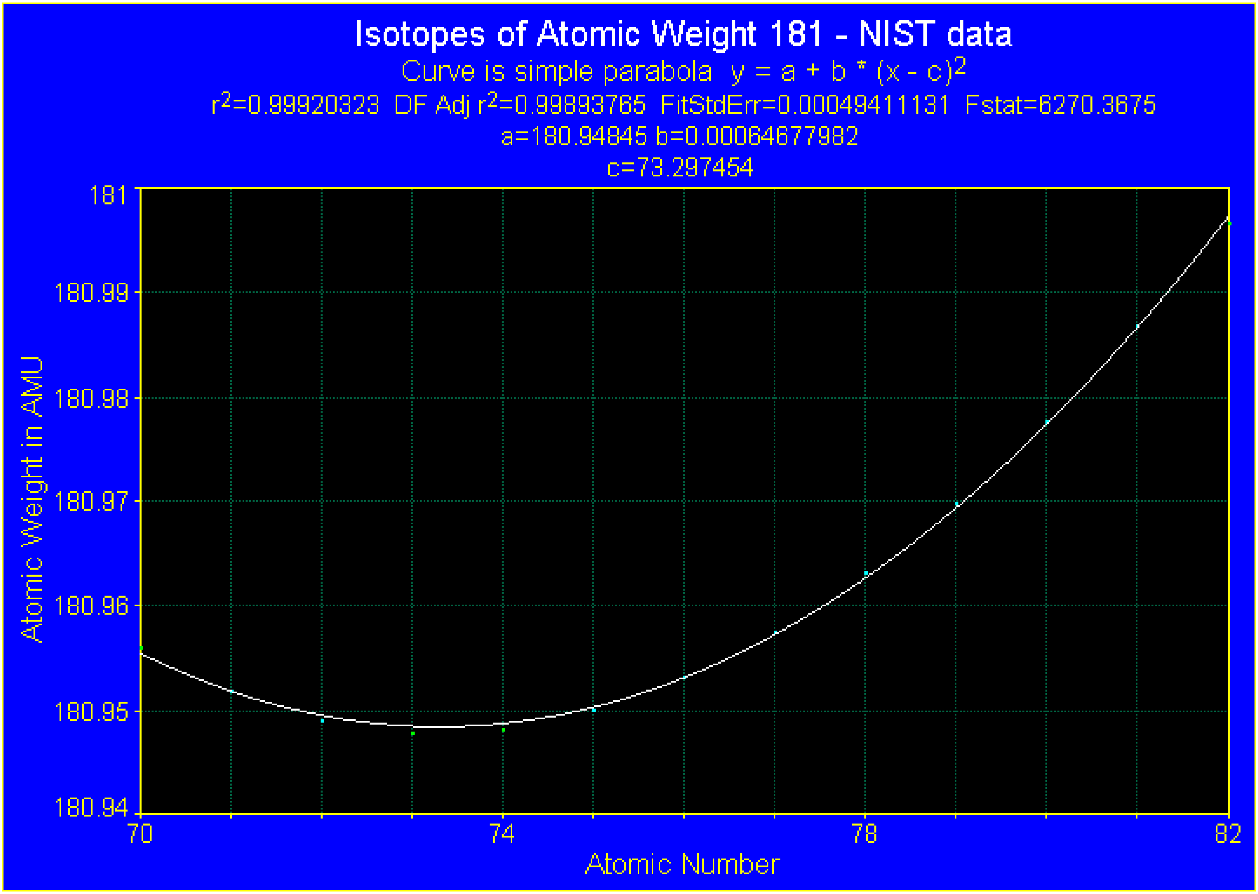
This Strong Force therefore represents a primary Binding Energy which was postulated to be holding nuclei together, overcoming the also strong repelling effects between any pairs of positively charged protons. (There was no actual experimental evidence for the existence of such a Strong Force.)

In addition to the Strong Nuclear Force binding energy, there must also be a binding energy that holds internal neutrons together. Free neutrons have been studied regarding their natural decay and that binding energy is known to be around 0.78235 MeV (or 0.000841 AMU). There is also a very small factor in that there is one less electron orbiting the nucleus, so there is a difference in that ionization-related electron binding energy (rarely higher than 0.0001 MeV or 0.0000001 AMU). Conventional Physics also states that there are also many other binding energies described inside the nucleus, regarding various pions and neutrinos and other objects in the nucleus, as well as the energy equivalents of the rest-mass of such particles.

Therefore, that measured difference of NIST atomic weight MUST be due to a combination of these many contributions, but primarily due to the inverse-fifth-power (or similar) Strong Nuclear Force. This suggests that if we graph all the NIST atomic weights of isotopes of any one atomic weight, such as the 13 known isotopes of atomic weight 181, we should get a very complex graph. **Below is that graph of the NIST data straight from their web-site, without any adjustments or corrections. Why is it that when we graph that NIST data there is such an obvious and amazingly pure parabolic shape?** The first graph just shows the thirteen specific points representing the currently accepted (NIST) atomic weights of the isotopes of Element 70 through 82. The second graph is identical but also includes a best-fit parabola. The logic above, that of traditional Physics, suggests that this data should have extremely complex components, and probably contain a primary curve of an inverse-fifth-power shape. But it does not. In reality, it is remarkably close to being a simple parabola, with a statistical r^2 of over 0.9992!



When a best-fit parabola is added



These graphs are representative of all same-atomic-weight isotope families. The group for 181 was chosen here because it contains many known isotope members.

Consider for a moment that all 13 of the isotopes represented here have the exact same quantity of electrons and protons, if the constituent neutrons are seen as a combination of a proton and electron. Therefore, the amount of actual mass attributable to actual protons and electrons is identical in each case, and the different actual atomic weights are then purely due to differences in the binding energies, energy equivalents of pions, neutrinos, etc.

The Dominant Parabolic Shape

A parabolic shape, due to a quadratic equation, strongly implies a second-power dependence, and definitely not a fifth-power one. The curve is not even one where there is even the slightest hint of any higher power contribution! A strict statistical analysis of the data shows no contribution of any binding energy contributions of third-, fourth-, or fifth-power dependence, only the very simple $y = a + b * (x - c)^2$ second order parabolic equation. The curve-fit is so good, with the r^2 of 0.9992, and attempts at curve-fitting with third-, fourth, or fifth-power equations are so poor, that there seems little doubt that some very prominent second-power effect on binding energy seems to exist inside the nucleus of atoms. An examination of over 200 such graphs of the NIST data for each atomic weight always shows this extremely prominent parabolic shape.

It is noted that these graphs do not directly show any distance dependences. But the purity of the parabolic shape seems significant. If there were strong binding energies due to a higher-distance-power Strong Force, it is believed that these graphs would reflect that.

This second-power dependence might suggest that a second-power Nuclear Force is the predominant cause that is providing the bulk of the nuclear binding energy. From the isotope at the bottom of the NIST data graph (which is always a stable isotope, as discussed below), as the number of surplus neutrons or lacking neutrons is doubled, the total binding energy of the atom changes by a factor of four. It seems reasonable to interpret this as an electrostatic effect, involving a second-power distance dependence.

In any case, the lack of any curve distortions due to any very strong binding energy source seems to deny the possibility of the Strong Force existing in nuclei.

In a simple graph of the NIST data which only appears to show second-order effects, where is any effect of the Strong Nuclear Force? It is hard to imagine that such an over-powering force as one which overwhelms the intense electrostatic repulsion, would not somehow show itself by dominant binding energies in such graphs. But there seems to be no indication whatever of any such binding energies. How can the Strong Nuclear Force actually exist?

Intra-Nuclear Neutrons

In the discussion above of two isotopes, it was shown that the two were identical except that one had a neutron while the other had a proton (inside the nucleus) and an electron (orbiting). If we accept the standard view that there are "neutrons" inside the nucleus, then these two should be different in atomic weight by the equivalent binding energy of a neutron, 0.783 MeV or 0.000841 AMU. In order to make this graph even more accurate and valuable, it would then make sense to account for this 0.000841 AMU additional neutron-internal-binding energies for each isotope to the left in the graph. The isotope at the left has 12 additional neutrons inside its nucleus, and so that atomic weight value must be 12 * 0.000841 or around 0.01 AMU too high, as compared to the atomic weight of the isotope at the right. This effect would skew the graph, and by removing this skewing effect, the graph should become even more precise.

However, when that correction is made, for the universally accepted neutron-internal-binding energies, the data fit gets much worse! The statistical r^2 value drops to 0.99885. That is still a tolerable curve-fit, but it is worse than the actual data! This seems to imply that the binding energy that holds neutrons together might not actually exist inside the nucleus. Free neutrons certainly exist, and our experiments study them. However, this finding seems to suggest that they may not be actual neutrons inside the nucleus, that they may actually be distinct electrons and protons instead. Note that no significant energy seems to exist for the associated neutrinos either.

This shows up in every beta or Beta+ decay, but it is most obvious in the Tritium (H-3) decay into Helium-3, where the situation is quite simple and where the energy carried away by the escaping electron accounts for essentially all of the mass difference between the two isotopes (as discussed above). The fact that there does not seem to be any contribution in the total atomic weight for either the known neutron-internal-binding energy or any equivalent energy equivalent for neutrinos, seems to bring new questions into the picture.

In these seven years of studying these subjects, I have now come to believe that there are actually no distinguishable neutrons INSIDE the nucleus, that the components exist as separate and independent protons and electrons. This view resolves the matter of there not being neutron-internal-binding energies or energy equivalents of neutrinos inside the nucleus. However, it has rather massive side implications regarding whether the Weak Nuclear Force even exists or whether neutrinos even exist.

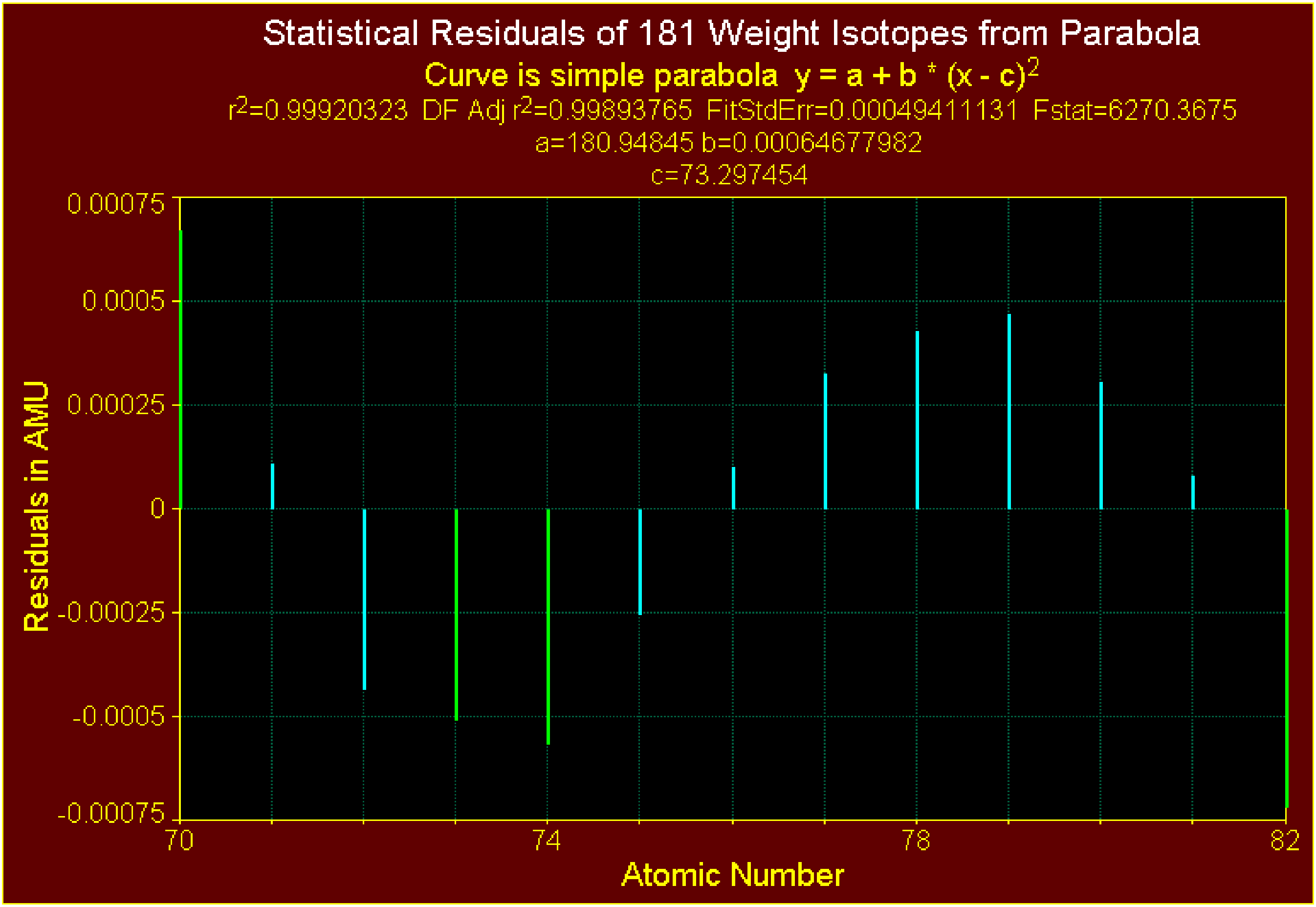
Please note that I have NO grudge against the Strong Nuclear Force, the Weak Nuclear Force, or neutrinos! It is just that these simple graphs of pure NIST atomic weights are SO impressively parabolic that I have found it impossible to avoid these concepts.

This Could actually be a Good Thing!

If it should be true that no Strong Nuclear Force and no Weak Nuclear Force can exist in the nucleus, AND if it should also turn out to be true that the extreme parabolic curve shape somehow implies that electrostatic forces are responsible for maintaining nuclear stability, then MANY things might become far simpler! The Standard Model of the nucleus might then be very well supported by theoretical basis. We might then no longer be having to resolve a GUT involving four Forces, but only two, Gravitational and Electrostatic. Better still, both of those are inverse-square, and possible compatible in some deeper sense. I would not be comfortable at damaging the position of the Strong or the Weak, since 70 years of Physics has been based on those concepts. But if the result is that a Unified Field Theory might become more possible, maybe it would be tolerable.

Possible Information on Nuclear Fine Structure

The shape of the NIST data graphs is NOT precisely parabolic, and even this seems significant. When the statistical curve-fit residuals are examined for each of the different atomic weight graphs, there are often prominent symmetries present in the residuals. Those effects seem to be on the general order of 1/3 MeV, and are usually 2-, 6-, or 10-symmetries. Here are the residuals from the 181 atomic weight parabolic graph fit shown above.



It is hard to ignore what appears to be a 10-symmetry in the results. These findings may provide some data on internal structure of nuclei, with the apparent possibility of some sort of shells, similar to the way the electron cloud has its own 2-, 6- and 10-symmetries, since of these various residual atomic weight graphs tend to have either a prominent 6-symmetry, a 10-symmetry or a 2-symmetry. There are also other patterns which seem to recur among the residuals charts. For example, if the atomic number and atomic weight are related by a simple fraction, there is usually a large preference (downward residual) (added stability for that isotope), while if either is a prime number, or if the two have no simple relationship, there is usually a strong negative preference (upward residual).

This research has been entirely based on the published NIST values of accepted atomic weights for isotopes. The initial intention and expectation was to detect evidence of an inverse-fifth-power or inverse-fourth-power component in the curve analysis. It was very surprising to find such a dominating second-power parabolic shape, and no indication whatever for any higher-power effects. **The meaning of such findings may be discussed, but they are there.** My personal conclusions may be argued, but it seems hard to see how actual neutrons really exist within nuclei. They would then certainly have to somehow form into a neutron when ejected. This process seems rarely needed, as remarkably few isotopes decay by emitting a neutron! It might be obvious that the original reasoning for the existence of neutrinos (also from the 1930s) would also seem open to question. If actual neutrons did not exist within a nucleus then how could a spin of 1/2 be attributed to them there? Free neutrons certainly have a spin (1/2) that is not equal to any scalar addition of the spin of an electron (1/2) and proton (1/2), but does that require the postulation of neutrinos (because it is defined as also having spin of 1/2 so a neutron can decay and Conserve angular momentum)? And would neutrinos then be inside the nucleus or somehow outside of the nucleus that emitted a neutron?

There appear to be a large number of implications of these findings. Some are mentioned and discussed here.

One consequence is that a relatively simple second-power equation can create the standard complicated binding energy graph. Another is that a logical and theoretical explanation from this analysis explains why Fissionable isotopes are only those with even-numbered atomic number and odd-number atomic weight, and why Fertile isotopes are only those with even-numbered atomic number and even-number atomic weight.

Decay Energy and Stability Predictions

In the initial NIST data graph above, The isotope 181 of Element 78 can beta+ decay into the isotope 181 of Element 77 by emitting a positron, or equivalently by capturing one of its own electrons (EC). The usual description of a beta+ decay is that one of its protons becomes a neutron (which remains in the nucleus, reducing the atomic number by unity, but which keeps the total atomic weight essentially constant) and a positron (which can be seen as joining an electron orbiting around the nucleus, and annihilating, or by being detected in experiments), therefore retaining the non-ionized state of the atom. This process can also be seen as an electron capture (EC), where an orbiting electron is captured into the nucleus, immediately combining with a proton to form a neutron. From this graph, the (predicted) vertical difference between the initial and final isotopes (along the parabola) is (180.96275 - 180.95731) or 0.00544 AMU, which is around 5.06 MeV. If we neglect any necessary binding energy regarding the Proton and electron to form a neutron (discussed below), there should therefore be around 5.06 MeV of energy created in this specific decay. The experimental NIST data says that it is 5.0 MeV, a very good prediction. This sort of prediction seems to be accurate for virtually all beta and beta+ decays, and so it seems likely to be valid regarding isotopes that have not yet been identified. It may be possible to predict the expected energy release of a beta decay from a presently undiscovered isotope, and if then found in a suitable experiment, there may be an additional way of confirming new discoveries of isotopes.

If there is such a simple second-power (parabolic) term that describes the entire change in the total atomic weight (the entire change in nuclear binding energy), that seems to imply that only a second-power force must be acting. That seems to disagree with the higher-power Strong or Weak nuclear forces, and more directly seems to point to a possible electrostatic force acting.

Every family of same atomic weight isotopes has been examined, and the same prominent parabolic shape dominates every graph where there are enough family members for statistical validity. This seems to imply that a second-power effect within the atomic weight, directly related to binding energies, must be present, in all isotopes of all elements. Further discussion of this will be below.

From the same initial NIST data parabolic graph, there appears to be additional information that seems to be pretty reliable. The absolute value of the slope of the parabola (times a constant) at any given Element provides a surprisingly reliable prediction of the negative log of the half-life of that isotope. Near both ends of nearly every such graph, the slope becomes high enough to represent a half-life of around 10^{-23} second, probably about the shortest interval a distinct isotope could exist. (This is approximately the time it would take to cross an average nucleus at the speed of light.) This seems to then imply that the 181 family of isotopes is "nearly complete" toward the higher atomic number end but that there should be some currently undiscovered isotopes such as ${}_{69}Tm^{181}$. There are several atomic weight graphs like this where the slope never gets that steep, which might suggest that certain specific isotopes might yet be discovered.

Near the bottom of each parabola, the longer half-life isotopes are always included, where the slope is lowest. For different atomic weights, there is sometimes an isotope near the very bottom of the parabola, which is ALWAYS stable. In this case, it is ${}_{73}Ta^{181}$. The graph has very little slope there and there is no lower available isotope (of weight 181) to either beta- or beta+ decay into. The graph therefore predicts that ${}_{73}Ta^{181}$ is stable, and it is. There are some graphs where two isotopes are about equally distant from the bottom, and these two are either both stable or both with relatively similar long half-lives.

The adjoining isotopes, ${}_{72}Hf^{181}$ and ${}_{74}W^{181}$ are at locations on the graph where the slope is low, which predicts they are unstable but that they have relatively long half-lives, with W being longer. This agrees with experimental evidence, where ${}_{72}Hf^{181}$ has a half-life of 42.4 days and ${}_{74}W^{181}$ has a longer half-life of 121.2 days. Where the slope is steepest, for ${}_{81}Tl^{181}$ and ${}_{82}Pb^{181}$, the predicted half-lives are less than one second, and that agrees with experimental evidence. This type of analysis suggests that the hypothetical isotope ${}_{69}Tm^{181}$ should have a half life of maybe 2 minutes or so, and that around 4 MeV should be created when it beta- decays. This analysis therefore predicts certain future discoveries of isotopes while also predicting that others will probably never be detected.

For atomic weight families of even atomic weights, there are two additional small factors, both of which seem to be electrostatic two-symmetry preference effects, which will be discussed below, which add some consistent wiggles in the graphs. In certain (even atomic weight) isotope weight families, there is an (odd atomic number) isotope very near the center of the parabola which has an atomic weight that is higher than the adjacent even atomic number isotopes, because they each have an extra 2-symmetry preference (both even atomic weight and even atomic number). This situation for a few atomic weights causes the odd-atomic-number isotope, which would otherwise have been stable, to be meta-stable, having both a beta+ and a beta- decay scheme. In the graph, the effect appears as an apparent high spot near the bottom of the graph, creating two stable isotopes of that atomic weight at the two slight curve minima. These graphs therefore predict meta-stable isotopes, which is in fact, always the case.

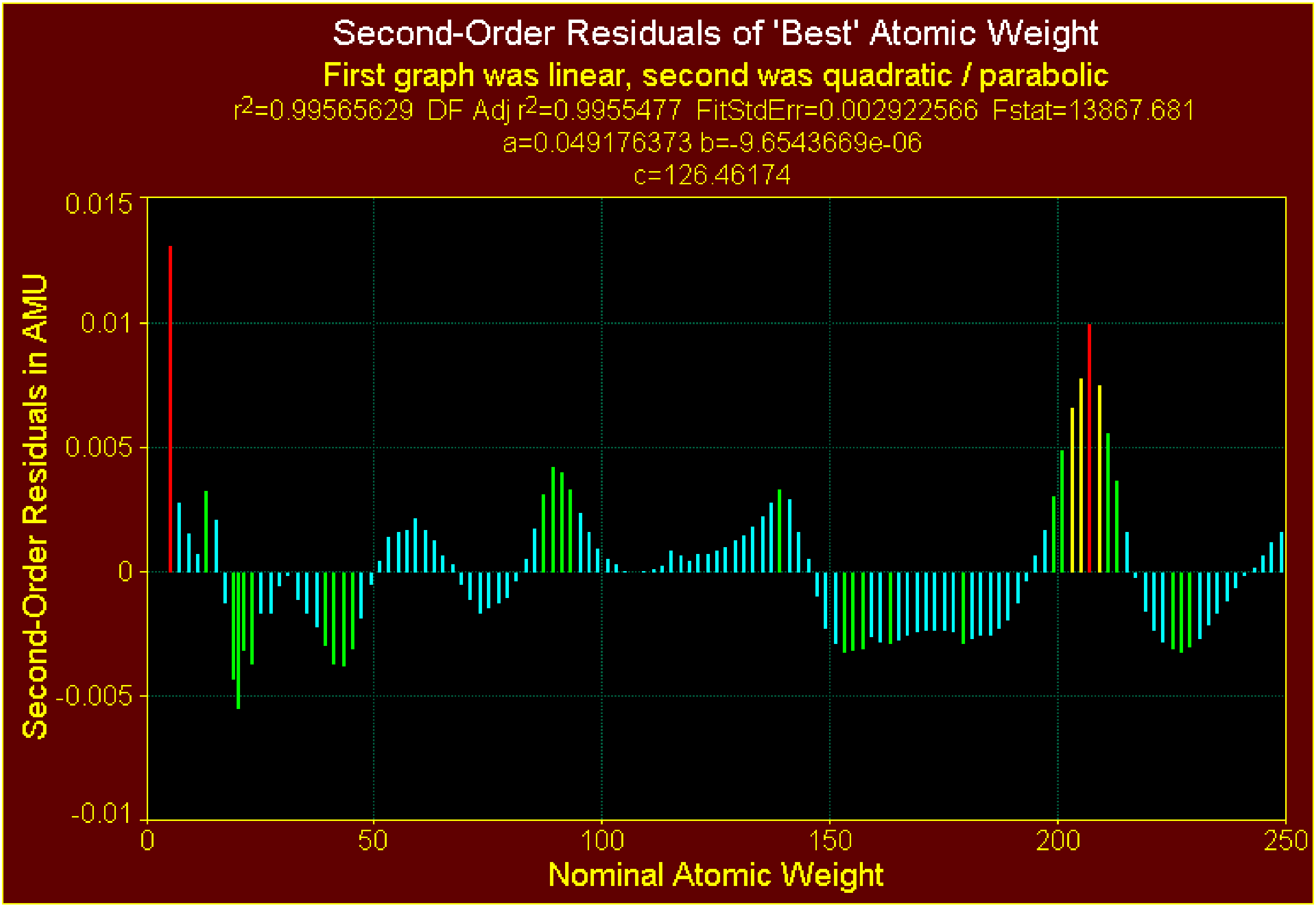
Each such graph has a specific lowest point of the parabola. There is not necessarily an actual isotope at that point on the graph. In the case of the 181 isotopes, it is an atomic weight of 180.948447 and it corresponds to an Atomic number of 73.297454. Each such graph has its own "preferred", most stable, atomic weight and number. If a graph is made of all those preferred values, we get another interesting set of information.

First, as expected, the graph of actual atomic weight (y) against nominal atomic weight (x), is essentially linear. When plotted against $y = a + b * x$, b is 1.0002129. This seems to suggest that an electron and a proton and nuclear binding energy must total 1.0002129 AMU or 931.64 MeV. Even more interesting are the residuals of such a linear graph:

When a best-fit parabola is added

This parabola is a surprisingly good fit, with an r^2 of over 0.995. This seems to provide even more evidence that the binding energies inside nuclei are second-order phenomena.

Equally interesting are the residuals of this statistical analysis.



There appear to be distinct patterns in this data. At around atomic weight 60, 90, 135 and 210, there are prominent upward features. These atomic weights are separated by factors of 1.5 to 1. Could this be some indication of internal structure in the nucleus? There may be "preferred configurations" of numbers of nucleons that represent "complete shells" such as with the orbiting electrons. For now, this comment must remain merely a speculation, but the regularity of these features seems important, and seems to be related to internal nuclear structure.

The graphs of all of the same atomic weight families residuals graphs have been examined. There appear to be quite a few that have ten-symmetries, quite a few that have six-symmetries, and some that have two-symmetries. It is interesting that the sub-shells of electron orbitals (s, p, d, f) have similar two-, six-, and 10-symmetries.

In the graphs of different atomic weight families, the phase of the residual cycle seems to vary. There is probably a meaning in this, which has not yet been understood.

It seems worthwhile to attempt to analyze the second-order residuals graph above for any indications of evidence for "completed shells" and then examine the various residual patterns for different atomic weights to see if there is any mutual confirmation. Between the two, there might be good evidence of specific internal nuclear structures.

The Mass Defect Chart

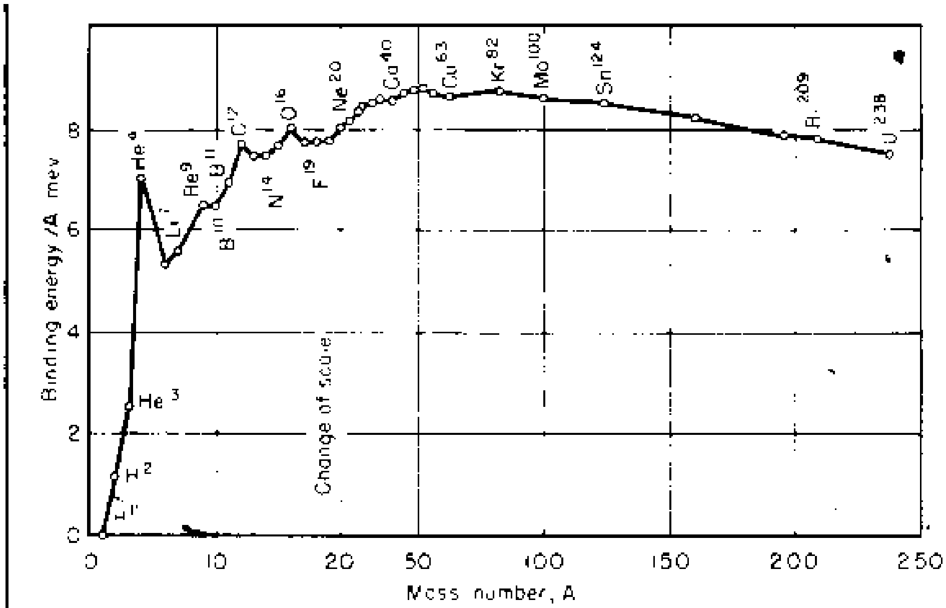


Fig. 1 Binding energy per nuclear particle for stable nuclei.

This graph is so irregular that it seems beyond mathematical analysis.

However, a very simple second power equation:

$$\textbf{Total Mass Defect} = k1 + k2 * W - k3 * (W - k4)^2$$

gives reasonably accurate binding energy/Mass Defects, and therefore predicts atomic weights for virtually all stable isotopes. A similar simple second power term may be added to apply to all unstable isotopes. (This particular graph is the Total Mass Defect divided by the atomic weight, so this equation must be divided by W to give this graph. It causes the natural parabolic shape of the curve to be distorted.)

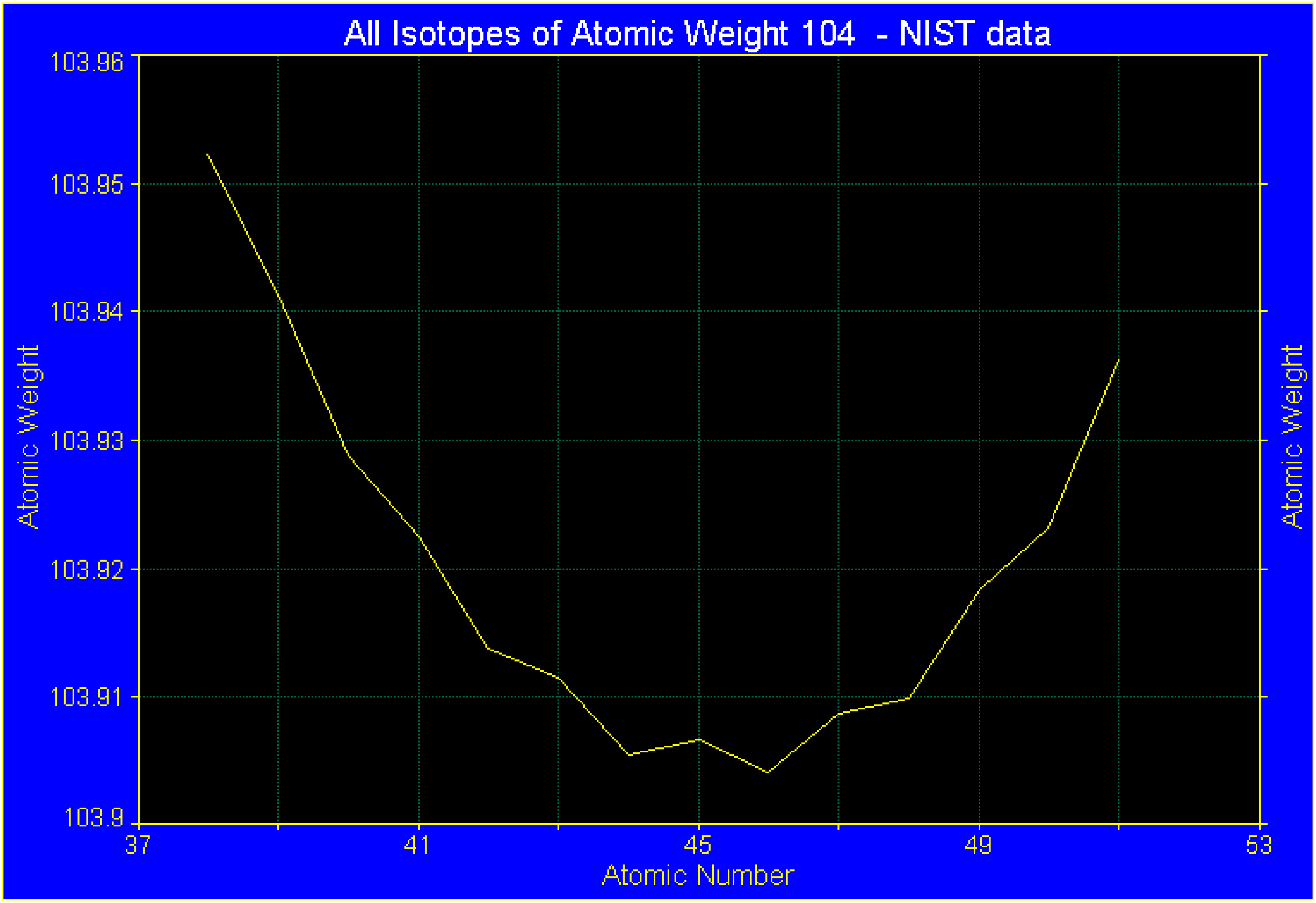
The values currently calculated for the constants are: k1 = 0.12158; k2 = .0080342; k3 = .0000096544; and k4 = 126.46. k3 and k4 are directly from the 'best weights' residuals parabola above (b and c in that equation). k1 is a composites of constants from the linear and parabola equations. k2 is related to the relationship between an AMU and a the mass of a proton plus electron.

The simplest form of the equation shown above is for odd atomic weight atoms. A relatively simple additional "preference" factor is needed to include even atomic weight atoms in the calculations. A crude version is to simply adjust the total for even atomic weights by 0.0140 AMU.

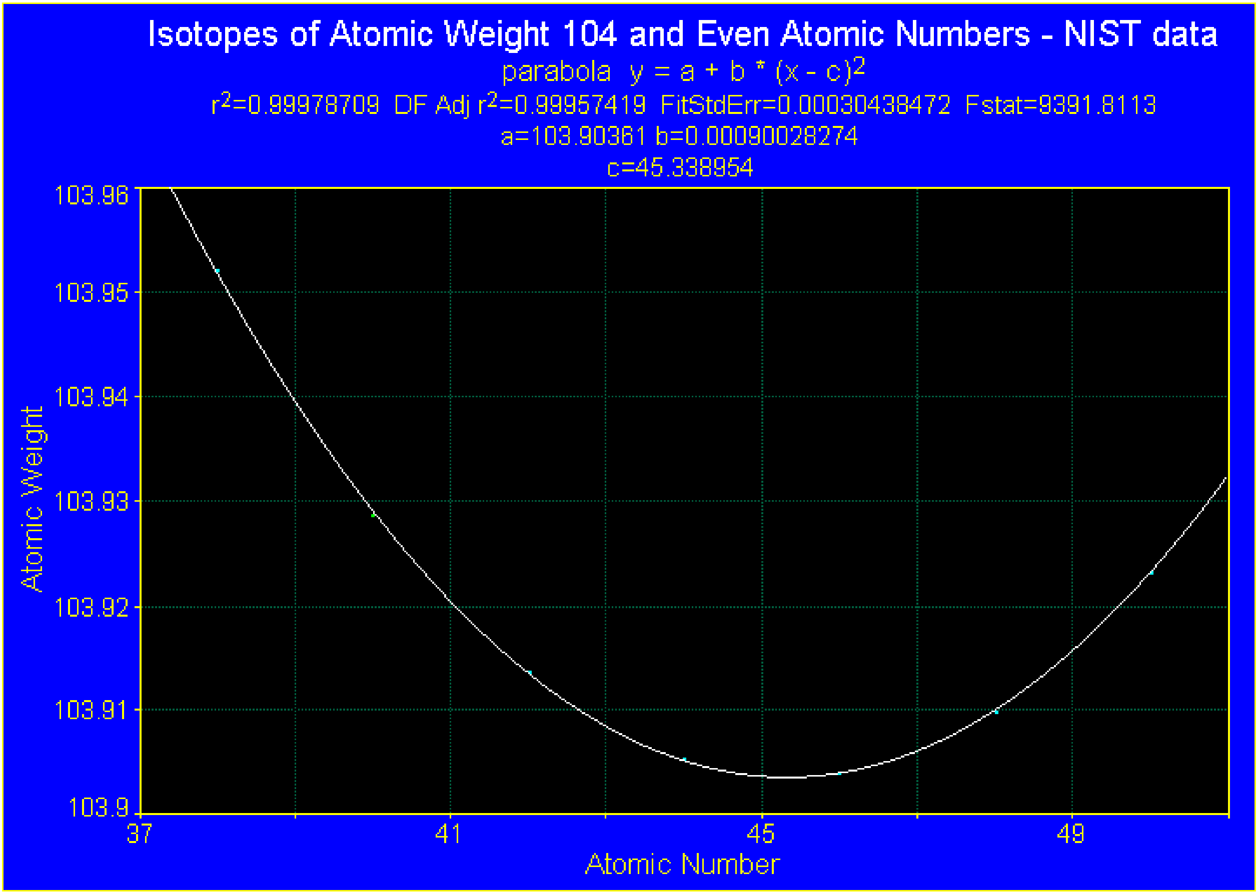
The equation above shows a maximum binding energy per nucleon at around atomic weight 56 or 58. This may be a confirmation of the general impression that the nucleo-genesis within supernova stops once Nickel-56 is formed. It may represent a theoretical reason why nucleo-genesis of higher atomic weight nuclei does not occur.

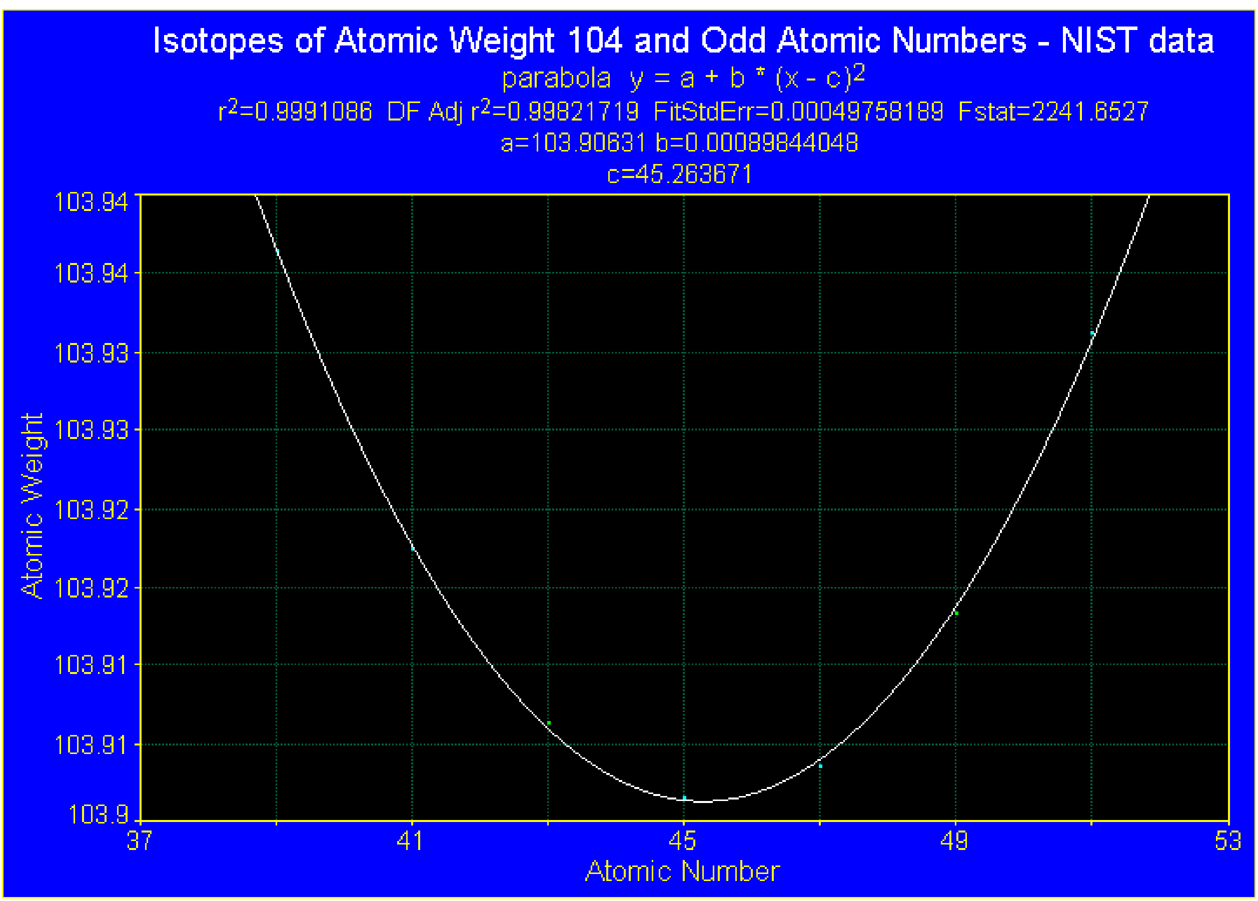
Analysis of Even-Atomic-Weight Data

The discussions above are all surprisingly valid and accurate when the analysis is for an odd-atomic-weight family of isotopes. When the NIST data of such a family of even-atomic-weight isotopes is graphed, the fit to a parabola does not initially seem very good.

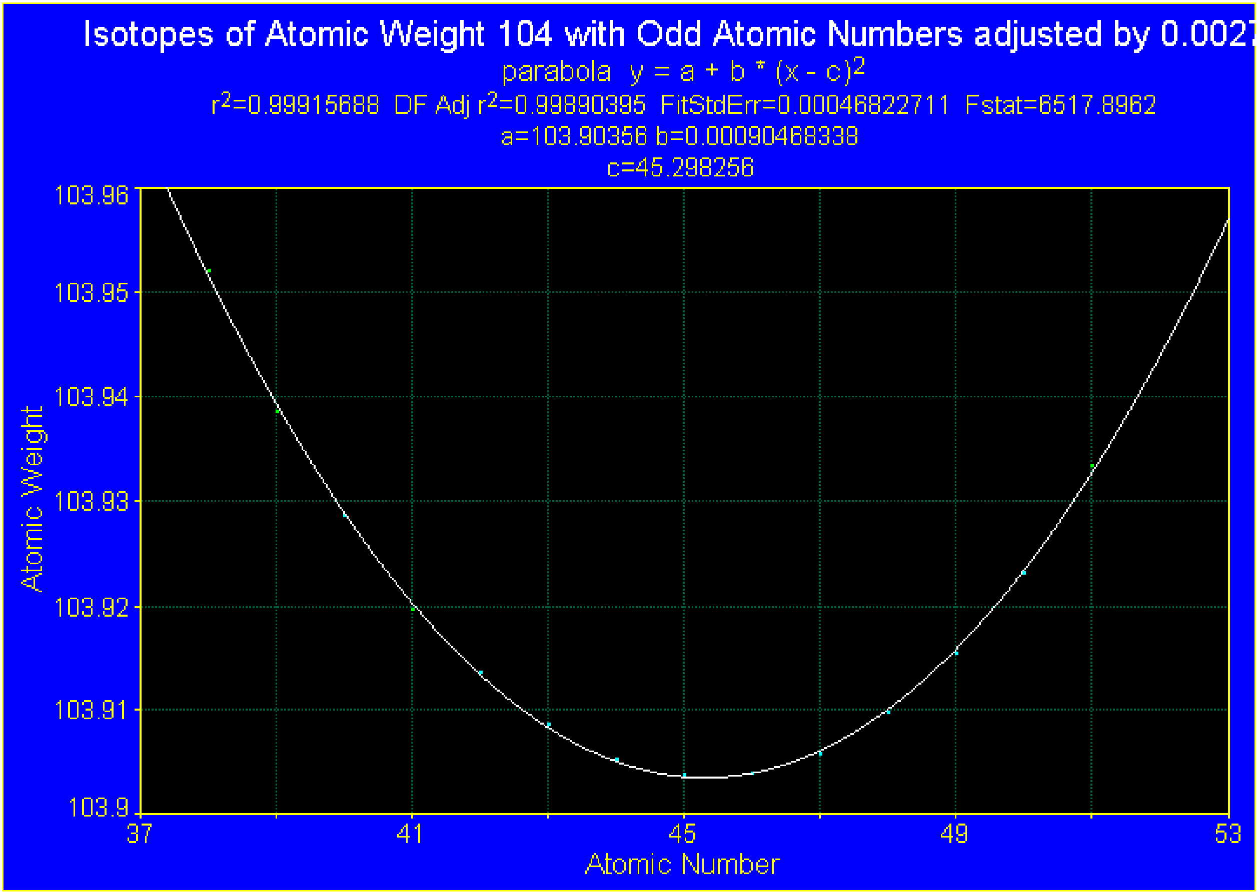


There is an extra step that is necessary for even-atomic-weight family isotopes, and it appears to provides information regarding another insight into nuclear structure. In this case, two separate graphs need to be made, one for the even-atomic-number isotopes and the other for the odd-atomic-number isotopes.


Isotopes of Atomic Weight 104 and Even Atomic Numbers - NIST data
parabola y = a + b * (x - c)2
r2=0.99978709 DF Adj r2=0.99957419 FitStdErr=0.00030438472 Fstat=9391.8113
a=103.90361 b=0.00090028274
c=45.338954
103.96
103.95
103.94
103.93
103.92
103.91
103.9
Atomic Weight
37
41
45
49
Atomic Number


Isotopes of Atomic Weight 104 and Odd Atomic Numbers - NIST data
parabola y = a + b * (x - c)2
r2=0.9991086 DF Adj r2=0.99821719 FitStdErr=0.00049758189 Fstat=2241.6527
a=103.90631 b=0.00089844048
c=45.263671
103.94
103.94
103.93
103.93
103.92
103.92
103.91
103.91
103.9
Atomic Weight
37
41
45
49
53
Atomic Number

Each of these graphs is a very good parabolic shape, having r^2 values of 0.999787 and 0.999109, respectively, each much better than the 0.99121 of the combined graph above. An important value in each of these graphs is the least value of the parabola weight, 103.90361 and 103.90631, respectively. These values are different by 0.00270 AMU. An interpretation is that an even-even symmetry (atomic weight / atomic number) has a structural advantage of stronger bonding (or better nuclear stability) than an even-odd symmetry, by an amount of 0.00270 AMU. With this assumption, we might adjust the weights of the even-odd isotopes downward by 0.00270 to account for such an advantage of the even-even isotopes. In this case, if we now graph the entire isotope family again, we get a parabolic shape comparable to those of odd-atomic-weight isotope families.



This graph has an r^2 of 0.999157, indicating a very good parabolic fit. This seems to confirm the advantage of 0.00270 AMU for nuclei which have an even-even configuration over that of an even-odd configuration. This seems to explain why we find that stable isotopes are extremely rarely even-odd isotopes (Nitrogen-14 is nearly the only common example) and are very commonly even-even isotopes. The discussion below will suggest that an even-odd isotopes might actually contain two odd quantities (of protons and of electrons) which might account for an extreme difficulty regarding mechanical symmetry and therefore stability.

Each of the hundred-plus even-atomic-weight family graphs seems to have a differential which is close to 0.0027 AMU. The fact that the same differential appears in all of those graphs and in none of the odd-atomic-weight family graphs seems extremely compelling and important.

This all seems to imply some important conclusions: (1) the "neutrons" within atomic nuclei may not actually be neutrons at all, but rather independent electrons and protons; (2) the lack of higher-power dependencies, and extreme prominence of second-order dependencies, in such graphs seems to indicate that no Strong Nuclear Force effects are present; and (3) there does not seem to be any contribution in the total atomic weight for pions or neutrinos, both of which are commonly thought to be present in great abundance. These are each surprising implications, and it appears that they may be inter-related.

There are several additional smaller factors which modify the precision which those parabolas give. The most prominent and consistent appear to be two 2-symmetries, which result in a natural stability preference for even-atomic-weight and even-atomic-number isotopes. The two-symmetry for atomic number appears to be on the scale of 1/3 MeV, while the two-symmetry for atomic weight appears to be around ten times that large, around 2.5 MeV. There appear to also be smaller 6-symmetries and 10-symmetries, for each, which slightly affect the final precise atomic weights. These factors appear to be very consistent, and simple terms may be added to the equations above to make they even more precise.

This new analysis appears to offer theoretical bases for many phenomena regarding nuclear structure, isotopic stability, and nuclear reactions. For example, it seems to theoretically explain/predict that odd-atomic-weights generally have only one stable isotope while even-atomic-weights generally have two (with a meta-stable isotope in between). Even the rare exceptions are seemingly explained. A theoretical basis seems to be provided for the approximate half-life of all isotopes, including the ones that are stable. There is a theoretical implication that virtually all possible isotopes have already been found and measured, with a few specific unfound isotopes to possibly search for.

The conclusion seems unavoidable that such simple second power terms are capable of very accurately defining the actual precise atomic weight of any isotope. That seems to imply that only second-power effects are acting, with the primary suspect being the inverse-square electrostatic force. This presentation is meant to demonstrate some examples of the analysis that resulted in the second-power equations, and then suggest a physical electrostatic mechanism that might be acting. If this premise is valid, then nuclei might be shown to be stable or unstable exclusively on the basis of electrostatic forces. No Strong Nuclear Force would need to exist to explain nuclear stability.

The simplified forms above are only accurate for stable isotopes of odd atomic weights. Simple additional terms (as mentioned, for various apparent symmetries) provide for unstable isotopes and for even atomic weight isotopes.)

There appears to be the possibility that several internal nuclear processes must be describable in terms of pure electrostatic interactions, where the Strong Nuclear Force and/or the Weak Nuclear Force may not even be necessary for the description.

My studies during the past several years have suggested the possibility that simple electrostatic attraction and repulsion of protons and electrons inside the nucleus might describe everything that is detected in experiments. This will be discussed below.

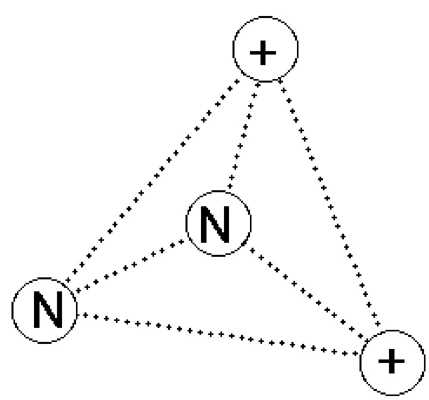
After studying this data, these graphs and their implications for more than four years, I now find it hard to deny an electrostatic force as virtually the exclusive cause of binding energies within the nucleus. I have rigidly attempted to avoid making any assumptions that might damage this analysis.

The prominent parabolic shape of such graphs suggests a seemingly logical explanation of nuclear stability without having to require a Strong Nuclear Force. This new perspective suggests that simple Coulomb electrostatic forces may offer a straightforward explanation of nuclear stability, and even possibly explain many aspects of variations such as predictions and calculations regarding radioactive decay.

A suggested situation is similar to the structure of a crystal where positive and negative ions are maintained in a stable arrangement due to a "lattice energy", which is entirely an electrostatic phenomenon. Reasoning very similar to the electrostatic arguments regarding orbital electrons and regarding interactions between atoms, particularly in crystalline structures, might be applicable. It also includes the possibility that the Heisenberg Uncertainty Principle might permit the electrons within a nucleus to seem to be at various specific locations as appropriate. The following argument seems to provide compelling evidence that the Strong Nuclear Force is not necessary in keeping nuclei in stable arrangements. The evidence below seems to suggest the possibility that atomic nuclei may actually be composed of 'A' protons and 'Z' somewhat free-ranging electrons.

A simplified example can be presented which gives the basic premise. It will be clear that the concept would apply to all nuclei that are more complex, although there are some slight variations that will be discussed. We will consider a standard Helium atom nucleus, which is generally described as containing two protons and two neutrons. For the sake of this discussion, we will consider the nucleons to not move and to be in a formation of a tetrahedron, where the four nucleons are all equally distant from each other.

Traditional Explanation



The two neutrons are essentially ignored, as being electrostatically neutral, and really only acting as spacers to keep the protons farther apart. The two protons each have a positive charge of $4.80294 * 10^{-10}$ electrostatic units, and they are approximately 10^{-13} cm apart. Therefore, they electrostatically repel each other with a force of

$$F = (q_1 * q_2) / r^2$$
or
$$F = (4.8 * 4.8 * 10^{-20}) / 10^{-26}$$
or
$$2.3 * 10^{+7} \text{ dynes.}$$

Such a large repulsive force would clearly cause the two protons to accelerate away from each other, outward, disrupting the integrity of the nucleus. Therefore, it had been concluded as early as 1935 (by Hideki) that no conventional Physics explanation could explain why a nucleus would not immediately fly apart. The solution given was that there MUST BE a Strong Nuclear Force, which is attractive and which has a distance dependence that is far higher than the inverse square dependence of the electrostatic (Coulomb) repulsion. Its attraction at the short ranges within the nucleus therefore overcomes the electrostatic repulsion of the protons to keep the nucleus together.

This Strong Nuclear Force has such a short effective range of action that it would never have any significant effect outside the nucleus, and therefore not alter any other physical actions. But the Strong Nuclear Force has never had any theoretical basis of existence, except for the fact that it "must" exist to counteract the mutual electrostatic repulsion of the protons. There has really never been any compelling evidence that it actually exists. However, virtually all of modern particle physics is greatly based on it.

The analysis of the NIST data above seems to argue against the existence of a Strong Nuclear Force. It does not seem to show any binding energy contribution to the total mass of atoms, and there is not even any contribution to the total mass from the pions which are believed to carry the Strong Nuclear Force inside nuclei. This seems to present a problem.

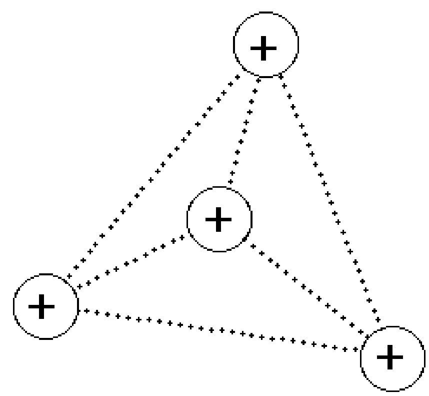
It might be noted that no significant assumptions were made in any of the above discussion. The universally accepted NIST data was simply graphed in a specific way, standard statistical analysis was applied, and the results were considered. This seems to be in marked contrast to the hundreds of speculative assumptions that seem to regularly be applied today within Physics. I am sometimes ashamed at the outrageousness of some assumptions that are put forth, and then generally accepted. What has Physics come to?

The following sections DO involve a limited number of assumptions, which I have tried to identify and document as credible. But since assumptions are involved, the following comments could be reasonably argued.

Positive protons repelling each other

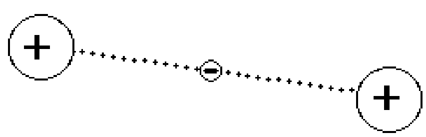
Without needing a Strong Nuclear Force

Given that even free neutrons are very unstable, breaking apart into a proton and an electron with a half-life of less than 12 minutes, does it seem logical that they maintain their structural integrity inside the hectic nucleus? The data analysis above seems to strongly suggest the possibility that in the nucleus, those protons and electrons are rarely or never actually bound together as neutrons. In other words, all four nucleons of the Helium nucleus could be considered to be protons, with two somewhat free-ranging electrons positioned or moving among them.



This would initially seem to make the situation even worse! Now we are considering FOUR positively charged protons each repelling each other with extremely powerful forces! On first glance, this might seem even less stable. But that may not actually be the case.

Consider the situation where one of those two electrons is momentarily at a point halfway along the line joining two of the protons, exactly at a midpoint of one of the edges of the tetrahedron in our drawing. For the moment, ignore the other components of the nucleus and just consider these three objects, proton, electron and proton, which are equally spaced along a straight line.



One of the protons and the electron each have opposite electrostatic charges of $4.80294 * 10^{-10}$ electrostatic units, and they are approximately $5 * 10^{-14}$ cm apart (half the previous distance). Therefore, they electrostatically attract each other with a force of

$$F = (4.8 * 4.8 * 10^{-20})/ 0.25 * 10^{-26}$$

or

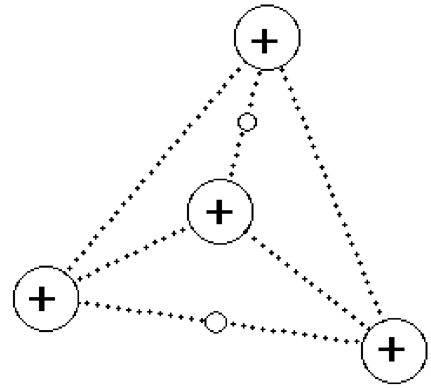
$$4 * 23 * 10^{+6} \text{ dynes.}$$

This electrostatic attractive force is four times stronger than the repelling force that still exists between the two protons. This would result in a NET ATTRACTIVE FORCE acting on each proton of three times the original electrostatic repulsion of the two protons (+4 -1). This is equally true for each of the two protons involved. Therefore, the resulting effect would not be of the protons flying apart, but actually being more likely to want to accelerate toward each other, actually toward the electron, with extremely high acceleration!

It might be pointed out that the attractive forces acting on the electron in this specific situation are exactly equal and opposite, and therefore it would experience no acceleration, even though its inertial mass is much less than either proton. The electron would be in a meta-stable situation.

We must now consider that this particular nucleus has six such center-point locations for the electrons to occupy to enable this effect, but there are only two electrons. The premise here is that if an electron stayed at any such center-point, the attractive force would be too strong, and it would quickly pull both protons toward it and nuclear instability would result. However, if the two electrons rapidly migrate back and forth among those six locations, they could reside in each center-point location for 1/3 of the time.

This (animation) drawing suggests how the two electrons might occupy the six locations for equal intervals of time, essentially 1/3 of the time at each location.



This situation would result in each pair of protons electrostatically repelling each other for 2/3 of the time, but then the presence of the electron at that center-point would cause an attraction that is three times as strong for the remaining 1/3 of the time, resulting in a net effect of an overall electrostatic attraction. Since these cycles would occur extremely rapidly, the averaged effect would be a time Integration of these effects. The result (in a stable nucleus such as He-4) would be an exact matching of attractions and repulsions and therefore of a nuclear stability and clearly the protons would not be exiting the nucleus.

These assumed oscillations might have some external effects. At a point where a nucleus became unstable, where an electron or proton left, the frequency might determine the frequency of the radiation emitted.

The simplified description above would actually result in too much attractive force.

It is certainly true instantaneous electrostatic attractions and repulsions from the other components of the nucleus make the calculations more complex. Also, the protons themselves are certain to be moving around, with variable distances between them. The electrons might require some migration time to get from one centerpoint to the next. A statistical analysis of time-averages is necessary to determine the net effects on each constituent part of the nucleus. For heavier atomic nuclei, this quickly becomes very complex mathematically. The premise suggested here is that such or similar effects would eliminate the apparent net attractive electrostatic force on each proton and provide at least a meta-stable neutral force on each, providing nuclear stability.

Known parameters of atomic nuclei provide a guideline regarding how rapid such migration would have to occur. We know that atomic nuclei are on the order of 10^{-13} cm in diameter. A proton has a mass of $1.65 * 10^{-24}$ gm. We calculated above the force of electrostatic repulsion, at $2.3 * 10^{+7}$ dynes. Assuming non-relativistic motions, and for minimal variations in the distances involved, $F = m * a$ or $a = F / m$, will give an approximation of the acceleration of the proton. This solves to an acceleration of $1.4 * 10^{+31}$ cm/sec^2.

We might consider an absolute limit of an individual proton's movement due to Coulomb repulsion from another proton, to be half the nucleus diameter, or $5 * 10^{-14}$ cm, if nuclear stability is to be maintained. Again assuming non-relativistic velocities, then $d = 1/2 * a * t^2$ or $t^2 = 2 * d / a$ or $t^2 = 7 * 10^{-45}$ or $t = 8.5 * 10^{-23}$ seconds. This value is not particularly precise because we did not consider the variable force due to the variable distances that exist, but it is only meant to give a ballpark idea of the time involved for the repulsion portion of this cycle. The entire cycle would then be on the order of 1.5 times that long or $1.2 * 10^{-22}$ seconds.

This reasoning represents the longest interval that the proton-proton repulsion could be in effect without the electrostatic repulsion destroying the integrity of the nucleus. Therefore, it represents a guide to the longest possible cycle time for the process described above. As long as the electrons complete their entire migration path in a shorter time than this, then the protons would not be de-stabilized, although they would likely experience a cyclic oscillation at that rate. If the cycle occurred more rapidly than that, the movements of the protons would be smaller and stability would be greater.

This situation suggests that the electrons, if described as moving, would need to traverse a cycle of three segments, or around $2.5 * 10^{-13}$ cm in a period no longer than $1.2 * 10^{-22}$ seconds, which implies a minimum velocity of around $2 * 10^{+9}$ cm/sec, about 1/15 the speed of light. This is interesting in that, should it be a higher velocity, then relativistic velocities of the electrons would increase their mass and possibly affect the reasoning regarding the mass defect and many other effects.

A second possible resolution of this net average neutral electrostatic force requirement might be that the individual protons and electrons might occupy a fixed lattice structure similar to the crystalline structure of some molecules. This approach might not require the rapid migrating of the electrons that would be required in the situation described above. With this reasoning, some stable mechanical structure might exist for each stable nuclear isotope configuration, that could maintain structural integrity. In a single plane, such an arrangement for the ^{4}Helium might resemble:

```
          P
         / \
P - E     E - P
         \ /
          P
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although in three-dimensional space it would certainly be different. The geometrical arrangement would need to be such that the attractive and repulsive forces on each of the six objects are equal and at least meta-stable. This concept seems to become more problematical for large nuclei, as the fixed location electrons would seem to be less likely to be able to apply all the necessary attractions to stabilize all of the nucleons.

The fact that certain total numbers of nucleons might geometrically reside in particularly symmetric arrangements might explain the greater stability of some elements and isotopes than others (Including explaining some of the preferred residuals discussed above). For example, it could be that the number of nucleons that would otherwise be stable for Technetium might be an inherently unstable configuration.

This line of reasoning also provides a possible explanation for the fact that the vast majority of stable atoms are described as having even numbers of neutrons. This reasoning would suggest that an odd number of neutrons would imply an odd number of internal electrons, which would possibly require much more specific geometrical requirements for the number and arrangement of the nucleons to provide a symmetry that is conducive to nuclear stability. An isotope that has an even atomic weight and an odd atomic number would therefore have an odd number of both protons and electrons in the nucleus. This seems like a credible reason why extremely few such isotopes are stable, Nitrogen-14 being the notable exception. If either the number of internal electrons or the number of protons is an even number, geometric symmetries seem more likely, and therefore better nuclear stability. If both the number of internal electrons and the number of protons is an even number, there seems to be even more potential for geometric symmetries, and this seems to give a theoretical explanation for why the vast majority of stable atoms happen to have such an even-even characteristic. The combination of the stability advantages of the two independent symmetry sources provides extremely stable nuclei. Other considerations along these lines will be discussed regarding the graphs below.

Most symmetry arguments can also be applied to the migrating nuclear electron premise described above. An even number of neutrons would mean an even number of migrating electrons, which might then act in concert in symmetric manners to establish especially stable nuclei. Along this reasoning, if both the number of protons and the atomic weight is even, the nucleus would be especially stable for having a double symmetry, so much so that an isotope of equal atomic weight and atomic number either one higher or lower is generally unstable with beta decay. This situation is generally seen to be true.

A third possible explanation to reduce the apparent electrostatic excess attraction is that the electrons are constantly moving in the spaces between the protons, either randomly or in some organized manner. In the first premise above, it was accepted that the electrons only existed in positions at center-points between protons, very much like the electrostatic-based structure of ions in crystalline structures, and they "migrated" among such points. In this premise, the electrons would be considered to travel along ballistic paths within the nucleus.

As the electron would proceed from being joined with (or near) one proton to the next, it would travel some path between the two protons, not necessarily a straight line. The cumulative (Integral) electrostatic Coulomb attraction force between each proton and the electron can be calculated, if assumptions regarding the electron's path and velocity profile are included.

There are a variety of ways the electrons might actually move within the nucleus. A more generalized form of the above argument involves taking the time integral of the attraction between each proton and the electron during whatever path is followed. For most geometries of electron movement, the resulting effect is a slight reduction of the net attractive force. The initial (migrate) argument above would have had too much attractive force for stability, and effects such as this might ensure that the time-average of the attraction exactly equals the time-average of the proton-proton repulsion, in making a stable nucleus. A discussion below will consider the situations where there are more or less than an optimal number of electrons within the nucleus, and the effects on stability, on the half-life and the radioactive decay schemes.

A fourth possible explanation might be that the electrons are generally bonded with individual protons, therefore enabling those protons to momentarily act as neutrons. This is a less satisfactory premise than the others above, as it does not actually provide any electrostatic attraction forces to counteract the proton-proton electrostatic repulsion. However, if the electron rapidly alternated between two of the nuclear protons of this reasoning, one of them would always be acting like a neutron, and therefore those two nucleons would not ever repel each other. Since there are four nucleons present, some two of them would always be acting as the protons and therefore repelling each other. On its own, this approach does not seem to provide any electrostatic attractive force to counteract that tendency, so it is probably to be dismissed.

However, this situation needed to be mentioned because it could occur for portions of the time cycles in the first premise suggested above. For example, for the Helium example discussed, consider if each electron resided bonded to each proton for 1/6 of the cycle, followed by an equal period of being at a center-point (with the net attraction) This would result in those two protons repelling each other for 2/3 of the cycle, because during the remaining time one or the other was acting like a neutron and not participating in mutual electrostatic repulsion. During the electron's 1/6 of the cycle at the center-point, it would cause the electrostatic attraction described above of four times the proton-proton repulsion force. Since this strong electrostatic attraction would then occur for 1/4 as long as the repulsion was present, the net effect would be of exactly canceling out electrostatic (e - p) attraction and (p - p) repulsion forces. This would provide for a stable or meta-stable nucleus.

All of the nuclear particles move internally at such high velocity that the precise location of each of the electrons is indeterminate in accordance with a Heisenberg type reasoning. This premise suggests that the rapidly moving negative electric charges could therefore be considered to be "joined" to individual protons or at the center-points in a statistical sense, to exactly balance out the electrostatic repulsions and attractions for macroscopic observations. This would then represent a purely electrostatic explanation for the stability of atomic nuclei.

Decay of Tritium

The beta decay of Tritium does not seem very compatible with conventional Physics understanding, where a Strong Force and internal neutrons are present. However, it appears to be an ideal example of how this approach seems to make sense.

According to recent NIST data, a Tritium atom has an atomic weight of 3.016049268 AMU. With a half-life of 12.33 years, it beta decays into Helium-3, which has an atomic weight of 3.016029309 AMU.

Those two atomic weights are extremely similar, only 0.000019959 AMU, which is equivalent to 0.0185906 MeV. This decay produces a beta- particle (an electron) which has kinetic energy of 0.01859 MeV. So, within an experimental error of around 10 electron-volts, the emitted electron carries away exactly the energy that represents the difference in atomic weights. That seems to imply that there was LESS THAN 0.019 MeV inside the Tritium that could represent the intra-neutron binding energy, a neutrino, and the Strong Force. Within experimental error, this seems to prove that those effects cannot exist within a Tritium atom. Just the binding energy holding a neutron together is far more than that, 0.782 MeV.

Notice also that the difference in atomic weight between Tritium and Helium-3 is essentially entirely accounted for by the kinetic energy carried away by the excaping electron. Less than 10 electron-volts appears available to account for an escaping neutrino.

There are only two known members of the atomic-weight-3 isotope family, so no parabola can be generated. However the very close exact atomic weights implies a relatively long half-life for Tritium (which is true) and that Helium-3 would be stable (and it is). According to this concept, there are three protons and three electrons in both of these atoms, the only difference being that one of the electrons is in the nucleus in Tritium and orbiting in Helium-3. The extremely small available difference in atomic weight seems to suggest that the total nuclear binding energy for the additional electron inside the nucleus must be 0.0186 Mev. The orbital binding energy of the other, the electron, is 24.6 eV or 0.0000246 MeV, an insignificant factor.

To summarize, there seem to be several possible alternatives regarding electrostatic processes that might produce the specific structure of separated nuclear electrons and protons within the nuclear structure:

- (a) the electrons might essentially only exist at the center-points between protons, rapidly migrating between the available locations;
- (b) the electrons might occupy fixed crystalline-like loci within a fixed pattern of the protons;
- (c) the electrons might travel on essentially ballistic paths from one proton to the next;
- (d) the electrons might merge with each proton in turn, causing each to momentarily act as a neutron and not be repelled, in an explanation more similar to traditional versions that include neutrons, or;
- (e) a combination of (a) and (e) might provide a purely electrostatic simple explanation for the exact balancing of attractive and repulsive forces to enable nuclear stability.

This reasoning suggests that nuclear stability might be understood to exist due to standard electrostatic Coulomb forces and that a Strong Nuclear Force may not be necessary. For the center-point example above, the simplified situation described above suggested a resulting attraction even greater than necessary to counteract the proton-proton electrostatic repulsion that has always seemed to be so irresistible as to require a Strong Nuclear Force to overcome it.

A stable or meta-stable nucleus would certainly require that the net attraction Integral exactly equal the net repulsion Integral, for each nucleon in the nucleus. The brief discussion above hopefully suggests that simple Coulomb forces can explain the observed stabilities of many nuclei.

Positron (Beta+) Nuclear Radioactive Decay

This reasoning suggests why all of the 186 known isotopes that have atomic weights less than twice the atomic number (except ^{3}He, a special geometrical case) are unstable with very short half-lives. There would not be sufficient numbers of these internal electrons to satisfactorily counteract the mutual repulsion of all of the protons. In essentially all such situations, another electron must soon be added to the nucleus. A proposed mechanism is that an impinging photon converts into an electron-positron pair, with the electron joining the nucleus (thereby reducing the atomic number by one) and the positron is emitted, to be detectable by research equipment. This new nucleus would be substantially more stable than its predecessor.

Even the single ^{3}He exception seems to agree with this premise. There would be three positive protons in the nucleus and one internal electron. That electron would have three necessary locations if the center-point premise is used, while it would provide three times the attractive force during that 1/3 of the time, a similar situation as the ^{4}He nucleus discussed above. Therefore, this premise even provides an explanation for why ^{3}He is the single exception in this category of isotopes.

Beta- (Electron) Nuclear Radioactive Decay

This premise also suggests a reason why isotopes that have a proportionately excessive atomic weight are also all unstable with very short half-lives, for having too many electrons within the nucleus pulling the protons around too aggressively.

It therefore appears to explain why beta- particles (electrons) are generally emitted during the radioactive decay of such excessive-weight isotopes. If one of the excessive number of internal electrons escapes the nucleus, it would appear as the very common beta- decay. The remaining nucleus would therefore increase in atomic number by one, and would be substantially more stable than before.

Electron Capture (EC) Decay

This process of decay would provide an additional nuclear electron identical to the result of beta+ (positron) emission. In this case, instead of an impinging photon being necessary to provide the necessary electron, it is obtained from an inner shell of the electrons external to the nucleus. The result is the same in creating a more stable resulting nucleus.

Preference for Beta- or Beta+ or EC Decay in Light Nuclei Isotopes

The "single atomic weight" graphs for lower atomic weights tend to have much steeper sloped curves than for higher atomic weights. Since one conclusion of this analysis is that the slope of those curves represent an indication of stability regarding beta decay, there is the implication that heavier nuclei would more rarely emit beta- or beta+ particles, which is borne out by experimental evidence.

Preference for Alpha Decay in Heavy Nuclei Isotopes

A similar analysis of actual atomic weight graphs shows an entirely different pattern regarding decay involving alpha particles. For light nuclei, the curve is inverted which suggests that alpha particle emission is not possible. For the heaviest isotopes, the slope of such curves exceeds the slope of the curves for beta decay, which suggests a natural preference for alpha decay for such isotopes.

In addition to this, the universal extreme symmetry preference for isotopes with even numbers of protons and also even numbers of neutrons seems to suggest a special stability of ^4He nuclei, which is the alpha particle. This symmetry-based stability might suggest that such structures exist within heavy nuclei, which might explain why they leave the nucleus as a bundle as an alpha particle. This might imply that within heavy nuclei there are distinct organized structures, the simplest of which would be the alpha particle.

There are many other interesting possible implications of this new premise.

An extremely careful analysis of this graph shows that all nuclei which have even-numbered atomic numbers are very slightly lower than the odd-numbered atomic numbers. For this atomic weight (99), the difference is roughly 0.0004 amu, on the scale of 400 KeV. This effect is interpreted as a geometrical preference for nuclei that have even-numbers of internal electrons, as implying that a better internal symmetry might exist as compared to if there are an odd number of internal electrons in the nucleus. Such a nucleus has a lower actual atomic weight and therefore a greater resulting binding energy, and is therefore a slightly more stable nucleus.

From this same graph, the slope of the curve at any specific atomic number seems to regularly be reasonably accurate at predicting the negative of the log of the decay half-life; elements farther toward the sides of the graph invariably have extremely short half-lives, all of which result in Beta- decay (left side) or positron+ decay (right side).

In the case of this graph for atomic weight of 99, only one element is stable, element 44. All of the other isotopes decay radioactively. Element 41 has a half-life of 2.5 minutes; element 42, 67 hours; element 43 has a more complex action, of first 5.9 hours and then 50,000 years; and element 45, 4.5 hours. All of the others have very short half-lives. The low slope of the graph at element 43 suggests that it might be nearly stable, which is somewhat confirmed by the very long half-life of its state after the internal transition. As indicated above, all on the left slope decay by emitting a Beta- and all on the right decay by emitting a positron+.

This page is at:
http://mb-soft.com/public2/nuclei6.html

This presentation was first placed on the Internet in November 2003.