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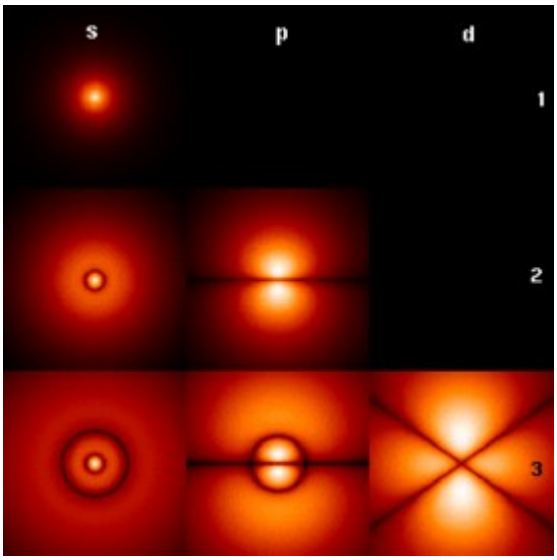
The NUCLEAR SHELL Model of WIGNER

plus a mechanical explanation
of the Pauli exclusion principle



by Miles Mathis

When I first published my recent paper on nuclear structure, I was reminded by several people that the nucleus had already been modeled many times over the years. The most famous model is probably that of Wigner, Goeppert-Mayer, and Jensen, who won the Nobel Prize in 1963 for work they did in the late 40's. But I consider my point in that paper to stand, since a diagram is different than a model. And what I said is true: their work is now mostly buried, for good reason. To see that it is buried, you only have to look at the pages on the nucleus at Wikipedia. Wiki knows that readers love diagrams, and the science pages are purposefully filled with illustrations and diagrams and macromedia presentations, to help sell the current theories. But the page on the atomic nucleus has no diagrams or models, beyond the Helium blur. And if you take the link to "nuclear shell model", you again get no diagrams. You get some tables, but those aren't even models. They are tables.

To see *why* the shell model is buried, you only have to read what it says on the atomic nucleus page:

There are many different historical models of the atomic nucleus, none of which to this day completely explains experimental data on nuclear structure.

And even that is overselling, because it implies that some of them *almost* explain data, or that all of

them together explain data. That isn't true. None of them is successful at all. They are very unsuccessful. My model "doesn't completely explain" data, because I am not finished with it. I just started it last week. But these other models "fail to explain data," because as models they fail. They were given decades to push themselves to some better or more complete form, and weren't able to do it.

More proof of this is newer models like the Interacting Boson Model of Arima. If the shell models had been successful, Arima would not have bothered to come up with IBM. I won't look at IBM here or elsewhere, since no one has found it to be of much use. Arima has protons and neutrons pair up into bosons, but that hasn't explained anything.

I *will* look a bit closer at the old shell model, to show how it is different from mine and how it fails. Here is a good place to start:

In order to get these numbers, the nuclear shell model starts from an average potential with a shape something between the square well and the harmonic oscillator. To this potential a spin orbit term is added. Even so, the total perturbation does not coincide with experiment, and an empirical spin orbit coupling, named the Nilsson Term, must be added with at least two or three different values of its coupling constant, depending on the nuclei being studied.

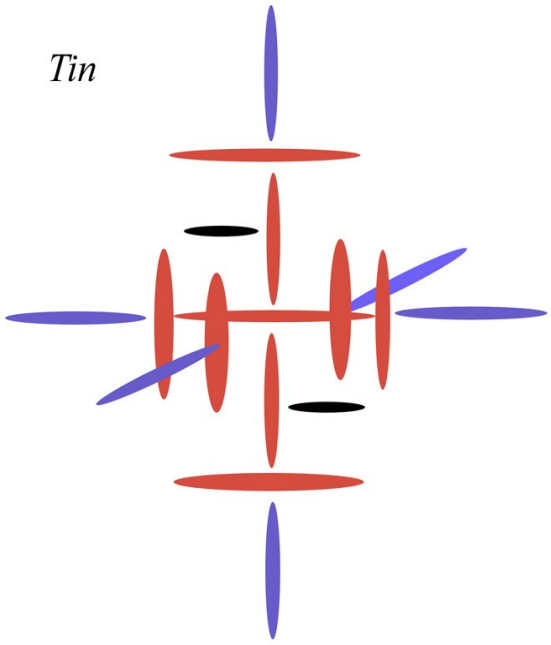
As you see, the model is not built on any field mechanics from the start. It starts from an average potential. That isn't mechanical diagramming, that is starting from the math. I create my structures from solid first principles, the main ones being balance in the charge field and channeling charge through the nucleus. But starting from an average potential is just starting from a statistic. Then they add a spin-orbit term. That is more unassigned math. They add a *term*, and a term is math. My diagrams are not built that way. I build my structure by mechanical rules and logic, not from mathematical terms.

Even though they start with the math and work backwards, they are way off track after just a couple of steps, which requires a very early and large push in the form of this Nilsson term. It is "an empirical spin orbit coupling." What? No mechanical assignment there, just a bunch of squishy words. And, it is just another *term*. What is empirical about it? It is a push to match data, but that doesn't make something empirical. Then we get the clincher: "it must be added with at least two or three different values of its coupling constant, depending on the nuclei being studied." At least two or three? We don't know? And if it depends on the nuclei being studied, it isn't really a model, is it? If the data is telling you the rules, instead of the model, then the model is worthless, and can't really be called a model. It is just a *table* of data.

Here's another example of the failure of the shell model, although it is sold as a success:

An example is the stability of the closed shell of 50 protons, which allows tin to have 10 stable isotopes, more than any other element.

I have diagrammed Tin, using it as proof of my theory, and it is disproof of the old shell model.



As we see, the shell is *not* closed. We should have known this from Tellurium, which I have compared to Tin in a previous paper. Tellurium is one of their own magic numbers, so they should have known this. Tin is not closed because Tellurium adds more protons *and* neutrons to the 4th level above Tin. To be specific, Tellurium puts more protons and neutrons in the inner holes, which are filled with black disks in the Tin diagram above. Those disks become blue in the Tellurium diagram, which means they are double filled rather than single filled. Those inner holes are "inner", but they are still considered to be 4th level or shell because they are above Xenon, and Xenon completes the 3rd shell at this level of construction. Therefore Tin is not magic by the definition given. It isn't filled by atomic number or atomic mass. Tellurium does meet the definition of a magic number, since the 4th level is completed by protons and neutrons. But the 4th level would be even more complete if we completed it with protons alone. Problem is, number 108 isn't magic with protons alone, since it is radioactive. I have shown this is because the inner nucleus is overspun by that many protons in the inner holes. Filling holes is magic sometimes, and sometimes it isn't.

A further problem is the explanation of Technetium. I have explained the radioactivity of Technetium using those inner holes again. But the old shell model explains Technetium as "the distance from shell-closure." In other words, the radioactivity must be due to shells that are very open. Is that what we find? Not at all. Technetium has more protons in the outer shell than the six elements before it (Rubidium to Molybdenum), and more nucleons also. Radioactivity has nothing at all to do with shell closure, and I have shown that with my diagrams. We see how naïve previous models must be to suggest open shells are the cause of radioactivity. If that were the case, all group 1 elements would be radioactive.

In fact, the mainstream admits that the old shell model fails most conspicuously in open shells, and this failure led to the Close-Packed Spheron Model of Linus Pauling and the 2D Ising Model of MacGregor, which use nucleon clusters. However, these models also don't use the simple alpha clusters I do, and they don't channel charge through the nucleus (since they accept the strong force and

think charge is virtual, why would they?), so they can't possibly approach the right structures. Pauling and MacGregor were both on the right track, *very* roughly, but didn't have enough mechanics to go on. I have shown that the nucleons do cluster, but they cluster mainly as alphas. It is crucial to get the first building blocks right, and they didn't.

Without much else to go on, the current models of the nucleus spend a lot of time talking about magic numbers, which is why magic numbers are still prominent. But I have already shown that magic numbers are oversold. My diagrams explain many many things that are more important than magic numbers, such as oxidation states, conductivity, electronegativity, and the Periodic Table.

We are told we can make the shell models even more complicated with a Woods-Saxon potential, but I have seen enough already. I have seen no sign of a sensible diagram or any mechanics, so I won't waste any more time looking around. All I can say is, "we gave people a Nobel Prize for this?"

I hope you will forgive me if I rush back to my own diagrams, which are like a day on the beach after a dark night in the forest, after reading this stuff. One of the first things I should look at to shore up my theory is the nuclear radius, which Wiki tells us any nuclear model must predict; and, as we know, if Wiki says it, it must be true. We are told that the nuclear radius is on the order of $R = r_0A^{1/3}$, where A is the atomic mass and r_0 is a semi-constant, being within 20% of 1.25×10^{-15}m. First of all, in my paper on the Rutherford experiments, I showed that current theory is off in its calculation of atomic sizes, so I can ignore the constant here. This constant is off by the amount of the fine structure constant. That is what the fine structure constant is—another fudge factor. But that means my nuclear radius should still be proportional to the cubed root of the atomic mass. Is it?

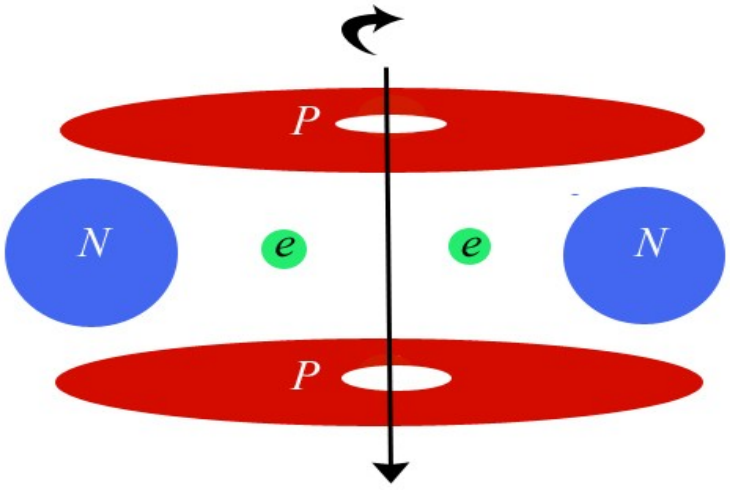
Before I show you that it is, I would like to tell you another secret. The reason quantum mechanics has been such a mess is that the theorists haven't understood basic things like "which things need to be predicted or explained first." They appear to think magic numbers are very important. They aren't. They think that the nuclear radius is a very important piece of data, but I am here to tell you it isn't. Of course we would like our models to match all data, but the nuclear radius is way down on my list. As I sought for the structure of the nucleus, about 20 things were more important to me than that. Among them: matching the Periodic Table, matching the noble gases, matching oxidation states, matching conductivity, predicting gas/liquid/solid, predicting radioactivity, and so on. We have seen that they don't even know what the nuclear radius *is*, so matching it is not a priority.

Now, any fool can see that the radius follows the cubed root of the atomic mass, simply due to the definition of density and the definition of a sphere. $V = M/D$, and with a sphere $V = 4\pi R^3/3$. $R^3 = 3M / D4\pi$. Take the cubed root of both sides, and you have it: $R = .62(M/D)^{1/3}$. We are just being told the nucleus is roughly spherical, to within 20%. Although my diagrams show that most nuclei are more hexagonal in structure than spherical, hexagons fit inside spheres quite easily, especially given a 20% variance.

But we can use my math to clarify a few things. My running of the equation gives us a density variable along with the others. Since we already have values for the other variables, we can calculate a density of the nucleus. $D = .185M/R^3$ (I used $\pi=4$ there). Let us calculate for Tin120, atomic mass about 2×10^{-25}kg. $R = 8.45 \times 10^{-13}$m (I corrected r_0 by 137 to get this). $D = 6.13 \times 10^{10}$kg/m^3. That density is

about 10^7 less than the current calculated density of the nucleus. The cause of that correction is the fine structure constant. Again, see my correction to the Rutherford formula.

But let us return to the earliest problems that have given the older models fits. One of these is Helium3. According to the old (and the current) models, Helium3 shouldn't be stable, not only because it is an odd number, but because the 1s orbital shell is open or unfilled. But according to my model, this is no problem, because shells don't need to be filled. We only have to have stability, and if stability can be achieved with "open" shells, the problem is solved. I mentioned Helium3 briefly in my first paper on building the nucleus, but only in passing. I didn't really explain the mechanics. In subsequent papers I answered some questions that had some bearing on this problem, but it is best to be explicit. So let us return to Helium3. In my recent paper on Oxygen, I showed a fuller diagram of Helium 4, which indicated the way charge is channeled through it. We saw that charge already moved in two possible ways: top to bottom and laterally. All larger nuclei showed the same pattern, but this pattern was already set with Helium.



The spin of the protons tends to recycle charge out laterally, and we may assume that most of the charge channeling with Helium 4 is lateral. But in an unbalanced charge field like we have—with more photons than anti-photons—another channel with be developed along the pole, indicated by the arrow. In a balanced field, we would get photons coming in the top hole and anti-photons coming in the bottom hole, so we would have arrows in both directions, but we won't concern ourselves with that. In our field, photons move down in this configuration, and so we have both vertical charge channeling and lateral charge channeling.

Given that, we can then understand the stability of Helium 3. Helium 3 only has one neutron to work with, so it places it in the middle, to block the vertical charge channel. In other words, the charge recycling holes are blocked from the inside. This forces all charge to be channeled out laterally through the protons' equators, and increases the angular momenta of the two protons. The neutron is held there by charge pressure from both sides, and now acts like the hub of a double wheel. The increased angular momentum acts to prevent the protons from turning toward one another. Think of a spinning wheel, which resists being pushed sideways (does the nucleus precess? We will see). This new configuration means the protons no longer need to be prevented from turning toward one another, since the charge field—and increased angular momentum—is now doing that work. The second

neutron is no longer needed, and the Helium 3 nucleus is stable without it.

You will ask why all Helium doesn't go into this configuration, since it seems a more elegant solution of the charge field problem. We can see why both configurations happen by going into a star, where Helium is made. Neutrons are present in great numbers, and under pressure sometimes one will get caught in between the protons and sometimes two will and sometimes more than two will. If only one gets trapped, the protons will turn and the configuration is destroyed immediately. If two get trapped, we get Helium 4. If more than two get trapped, one of them *may* go to the middle. This blocks the vertical channel, and the protons spin faster. As the protons pick up speed, the neutrons not in the middle hole will be thrown out laterally, along with charge. And one is left. That is your mechanics, and it explains how one neutron, which is not initially stable, *becomes* stable during the creation of the Helium.

But how about those electrons? How are the electrons of Helium 3 stable? Well, I assume that electrons enter the alpha after it forms. I have shown the minima that the two electrons fill in Helium 4, but in Helium 3 the minima aren't quite as easy to intuit. I would predict that the electrons in Helium 3 should be a bit further away from the pole, for obvious reasons. But we still have charge minima out there, even without charge being blocked by the two neutrons. Those two protons in Helium 3 are spinning fast, even faster than the protons in alphas normally spin. The more spin, the more charge pressure out there is. In addition, the charge, once it leaves the protons proper, will disperse. The gap between protons is already small, and this dispersal will act to close the gap even more. The external charge field is mostly blocked, because charge is moving out against it, you see. So electrons can easily hide in that gap.

Electrons seek charge minima for the reason everything else does. They are pushed there by charge. Those are potential lows in the field, and electrons and neutrons and everything else that isn't tied down will be pushed there. OK, but why only two electrons? It looks like there would be a low all the way around, big enough for lots of electrons. And if charge can't get in there, how do electrons get in there? I will answer the second questions first. These are charge lows, not charge zeros. You can't keep charge out of anywhere, you can only lower its density. Electrons are also very small compared to nucleons, so they have no trouble squeezing in the gap. The second question is better: why only two? There should be room in there for hundreds or thousands, it would seem. But no. Because there are two protons, there are only two electrons. You will say, “Wait, that makes sense only with current theory, where the electron has equal and opposite charge to the proton. You have given the electron much less charge, so how does that work?” It works because it has nothing to do with a plus or minus on the electron or proton. It has to do with the number of holes we have here, which is still two, one in each proton. Even with the neutron blocking those holes, we have leakage. Why? Because the hole is open on two sides, not just one. Return to my diagrams of the bigger nuclei, and study again the inner holes of the 4^{th} shell, which we saw were also open on two sides. To block them, we had to place neutrons on both sides. “So, put neutrons on the outside of this alpha,” you will say. Nature doesn't do that because sticking neutrons on the outside of single alphas or other small nuclei imbalances them too much. It only works with the inner holes of larger nuclei, which can be stabilized by the outer nucleons of the 4^{th} shell. Here, the mass of a single neutron is an appreciable fraction of the nuclear mass. You will say, “Then why can we stick a proton there, when we start building larger elements? Why a proton but not a neutron?” Because the proton is channeling charge through the hole. The neutron isn't. And when we put the proton in that outer hole, there is no neutron in the inner hole. When the proton is in the hole, it creates a charge pole, strong vertical charge, and more balance that way. The neutron doesn't.

We don't put neutrons in outer holes here, therefore the hole is being closed only by the single inner neutron. And so the hole leaks, enough that an electron in the interior will feel it. This pushes the first two electrons into orbits about those two holes. They are trapped between small charge pressure out from the hole and charge pressure in from the gap, and they find a distance of orbit that balances the two pressures. There is only one such stable distance that balances in and out, so it supports only one electron. A third electron that comes into the gap will be pushed to the same balancing points, but the existing electrons will interfere with them. The third electron will be jettisoned. In fact, both electrons may be jettisoned in the collision (or all three), and we have to start over. I have just given you the mechanical explanation of the Pauli exclusion principle. I have also given you one mechanism for ejecting an electron.

"But why can't two electrons go into that orbit?" Because the electron already in the orbit is moving fast enough that the new electron can't get up to speed in time to find stability. To keep from interfering, the new electron would have to enter the orbit at precisely the same speed as the electron already there. Otherwise they will collide. Well, the electron entering *can't* be going the same speed as the one already there, because it isn't being propelled in the same way. The one entering is following a pretty straight line toward the center, we assume, since it is being pushed in by the external charge field. The one orbiting is following a curve, being pushed by charge coming from two directions. The odds that the velocities will match is zero. The one coming in can't be going as fast as the one already there, so we must have a collision.

Because that is true, and because free electrons will continue to be pushed into the gap, we must assume that electrons are being ejected all the time, and that the filled orbital is being filled with a different electron every split second. Unless the external field is electron poor, we should have a swapping of electrons all the time. The orbital is filled all the time, but rarely with the same electron. This answers other questions in QED, as I hope you see.

It is my guess that you have never seen a real, physical explanation of the Pauli exclusion principle, or of any of this. I know I haven't. We are normally railroaded into uncertainty principles, fermions, half-integer spins, and a lot of other misdirection when we ask questions about the quantum level. All I can say is, go to the mainstream sources, read their explanations, and then read mine. If you prefer theirs, go along with my blessing. You will need it.