REGULARITIES IN THE GEOMETRIC MODEL OF THE CORE STRUCTURE.

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The purpose of this work is to study the regularities of the structure of nuclei in the framework of a Geometric model. It is shown how "magic" nuclei are formed by filling "vacancies" in the core structure with neutrons. It is suggested that the "stability island" ends with the 120th element of the Periodic system. The assumption that it has a weakly negative charge at a distance comparable to the size of a neutron provides a theoretical justification for the possibility of low-Temperature Nuclear Fusion Reactions (LENR).

Keywords: atomic core, magic cores, LENR.

Currently, there are almost a dozen models of the structure of the atomic nucleus, each of which explains only a limited set of nuclear properties. In General, the method of studying atomic nuclei by irradiating photons and other elementary particles can be compared to the method of studying a bag of vegetables by firing at it with stones of different speed and weight, and studying the range and angles of rebound of these stones. Of course, some information can be obtained from this method of studying the atomic nucleus. Thus, the shell model was obtained by a particular solution of the Schrodinger equation.

In this paper, we consider a Geometric model of the structure of atomic nuclei, which is a development of the shell model.

This core model is based on three assumptions :

1. the basis of the Geometric model is the shell model of the structure of the atomic nucleus. The structural regularities of the structure of atomic nuclei (nuclear shells) and atomic electron shells coincide. I.e., the number of electron shells and sub-shells and nuclear shells and sub-shells coincide.

2. the inter-Nucleon (nuclear) forces that hold down the nucleons in the atomic nucleus act only between a proton and a neutron;

3. the inter-Nucleon (nuclear) forces in the atomic nucleus have spatial anisotropy and act in the directions of the orthogonal axes of three-dimensional space. Each nucleon in the nucleus has a strictly defined place in space, dictated by the formula of the structure of the nucleus.

The first assumption, in principle, lies on the surface. If an atom has a long-known ordered structure in the form of electronic shells (K,L,M,N,O,P,Q,R) consisting of sub-shells (s1,s2,p1,p2,p3,p4,p5,p6,d1,d2......f14) then it is logical that the same ordering extends to the atomic nucleus, even if not in the same form.

The second assumption is based on elementary calculations of the Coulomb interaction of proton-proton, proton-neutron, and neutron-neutron.

The author knows that the official science stands on the position that the nucleons in the core are held by the so-called "strong interaction". It is called strong because of the decrease in the mass of nucleons in the nucleus, which, using the formula $E=mc^2$, gives energy values of the order of 7-8 MeV per nucleon. That is, the simultaneous appearance of forces holding the nucleons and the defect of their mass are considered to be related by cause and effect. But the simultaneity of two physical processes is necessary for establishing a cause - and-effect relationship between them, but it is not sufficient. It is quite possible that these two physical processes are both consequences of the third, (and maybe the fourth...).

As an example, a flash of light radiation and an acoustic shock observed during rain could be considered cause and effect, since they occur simultaneously. But in fact, both of these phenomena are the result of an electric discharge caused by the ionization of the atmosphere caused by the solar wind and the presence of a magnetic field on the planet, which is a consequence of the metal core of the Earth…

The internal structure of nucleons was studied by R. Hofstadter (Nobel prize in physics in 1961), and showed the spatial extent of nucleons and electric charges inside them, it is also worth remembering that the fact of rotation of the nucleus as a whole, established by L. J.Rainwater (Nobel prize in physics in 1975). But then the size of the nucleons and the rotation of the nucleus as a whole were all safely forgotten, and the nucleons were considered either point-wise or in the form of a certain wave function. The author considers this approach to be one-sided and does not fully correspond to the observed reality.

According to R. Hofstadter, nucleons consist of a "core" with a radius of 0.25*10-15 m, carrying 35 % of the positive charge, then the shell is up to 1.4*10-15 m. carrier of 50 % of the charge, positive for the proton and negative for the neutron, and a shell with a radius of up to 2.5*10-15 m, carrying 15 % of the positive charge.

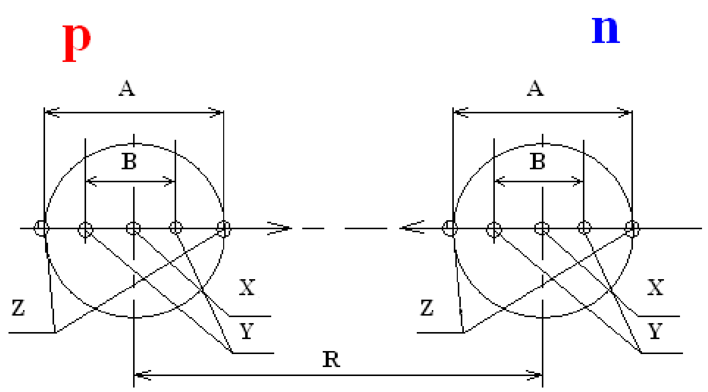


Figure 1.

The author made a simplification by representing the distributed spherical charges inside the nucleons (the second and third spheres) as two points of half the size at the same radius along the line of interaction of the nucleons.

For $A=5*10^{-15}$ m, $B=1.4*10^{-15}$ m, X= 35%, Y= 25%, Z=7.5 %, calculating the Coulomb interaction simplistically by the formula:

$F=\sum q_i*q_j/(r_{ij}+R)^2$; where r is the distance between interacting charges inside the nucleon, and R is the distance between charges between the nucleon centers.

We get that the graph of the Coulomb interaction of a proton-neutron pair represents a curve that is presented in all scientific literature as a graph of nuclear forces.

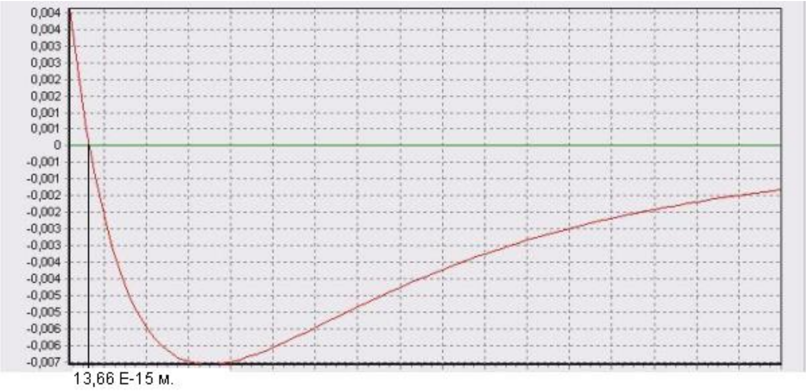


Figure 2.

The graph has an equilibrium point at a distance of $13.66*10^{-15}$ m. between the centers of the nucleons. This suggests that at distances comparable to the size of nucleons, the neutron has a weak negative charge. Moreover, the author conducted research that small changes in both the internal distribution of charges and their distances from the center of the nucleon cause the disappearance of the equilibrium point.

Coulomb interaction of proton-proton and neutron-neutron pairs at distances comparable to their sizes gives repulsive forces in any case. The author's conclusions about the Coulomb interaction of nucleons do not contradict any interaction of these pairs of nucleons outside the nucleus, especially when they are forced to collide.

The results obtained lead to the conclusion that the forces holding the nucleons in the core are Coulomb forces. It is quite possible to imagine them as elastic outside the equilibrium point and causing fluctuations of nucleons near this point when the nucleus is excited.

This contradicts the ideas accepted in today's physics about the nature of nuclear forces, which are considered as the result of the exchange of virtual Pi mesons. This contradiction is removed by simple logical reasoning.

So, we have three physical phenomena :

1. Convergence of proton and neutron;

2. Occurrence of holding forces with an equilibrium point;

3. The mass defect of nucleons.

It is customary to link the second and third observed phenomena with a cause-and-effect relationship. Although it is quite possible, and most likely, that the second and third phenomena are the result of the first, and have a different nature, although they appear simultaneously. The Coulomb interaction with the equilibrium point is discussed above.

Perhaps the resulting defect in the mass of atomic nuclei is explained by the fact that the nucleons, being themselves spatially extended objects and causing gravitational distortion of the surrounding space, proportional to the mass\volume, do not propagate through themselves other gravitational distortions.

Then the total gravitational field of the nearby nucleons is less than the sum of the gravitational fields of the nucleons separately. What to an outside observer is perceived as a defect in the mass of the atomic nucleus obtained from these nucleons.

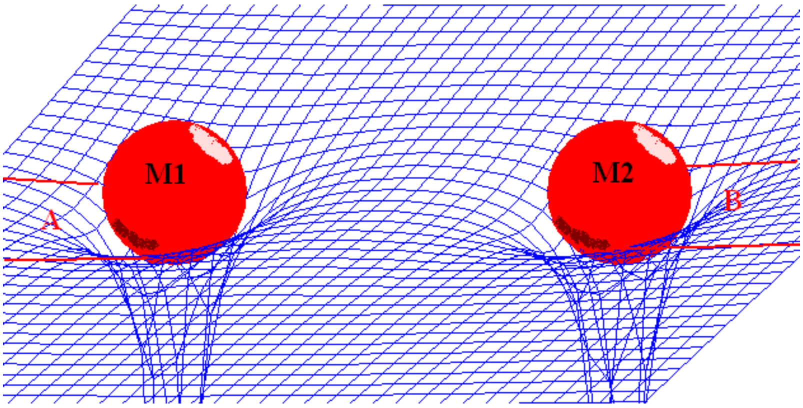


Figure 3.

Figure 3 shows the area of mass M1 and M2 that distorts space. A is the region of space where gravitational distortion from mass M2 does not extend, and b is the region where gravitational distortion from mass M1 does not extend.

The mass is equivalent to the deflection of a 3-dimensional space. Gravity slide in the direction of another large distortion of space. Inertia - rolling into its own distortion of space from its slope.

The third premise of the Geometric model is based on the conclusion obtained in Geometric Theory [1] that the outer quarks of nucleons have the shape of a cube.

Based on these assumptions, we get that the structural unit that distinguishes one chemical element from another is not a proton, but a nucleon pair : a proton-neutron.

Since the proposed structure of the atomic nucleus is somewhat similar to the shell model, we will also call the structural units of the nucleus shells and sub-shells. The algorithm for filling nuclear shells repeats the algorithm for filling electronic shells :

s1,s2,

p1,p2,p3,p4,p5,p6,

d1,d2,d3,d4,d5,d6,d7,d8,d9,d10,

f1,f2,f3,f4,f5,f6,f7,f8,f9,f10,f11,f12,f13,f14,

b1,b2,b3,b4,b5,b6,b7,b8,b9,b10,b11,b12,b13,b14,b15,b16,b17,b18;

Algorithm 1 - (1)

Fill rule (conditional): top, bottom, left, right.

The order of spatial filling of shells (Algorithm) is illustrated in figure 4.

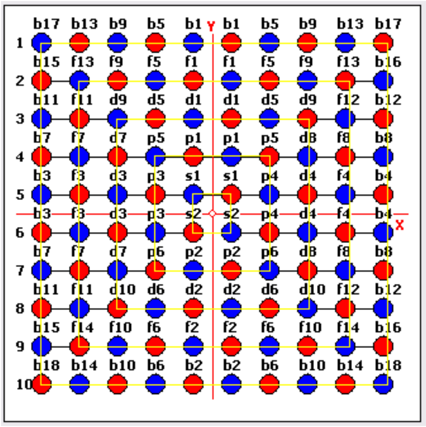


Figure 4.

In the program, click the Algorithm button at the top right, next to the cluster panel.

Yellow lines-squares are marked with sub-columns s, p,d,f, b.

Since the author assumes that the shells are filled with nucleon pairs, there is no room for extra neutrons in neutron-surplus nuclei inside the atomic nucleus.

The core structure composed only of nucleon pairs A=Z*2, we will call the main core. It is logical to assume that in this case, the neutrons are attached to the main core from the outside in spatial positions next to the protons. We will call these positions Vacancies. The vacancy rank W1÷W4 depends on the number of protons to which a neutron can be attached at a given position.

So the Core 2-He-4 has two filled sub-shells s1, s2 in the shell K and 8 vacancies W1 located in the shells J (2 units), K(4 units) L(2 units).

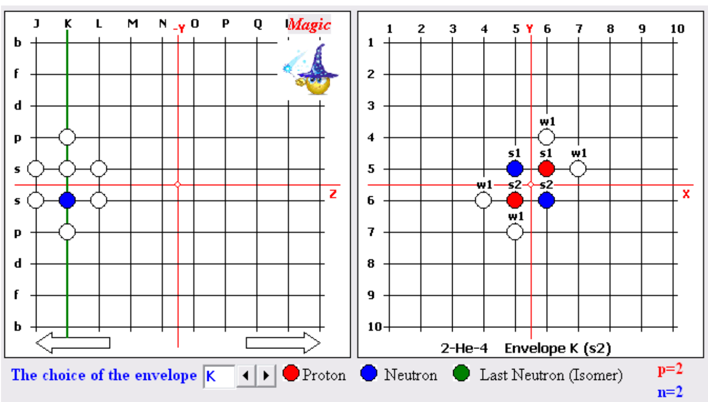


Figure 5.

Author's note: all illustrations of the structure of nuclei, graphics and other data are obtained by the author's computer program "Viewer of Structure of the Atomic Nucleus" (beta – 4.1).

You can download the beta version of the program here –

https://yadi.sk/d/WAuQu5ov3YYFpE

The structures of the nuclei of all nuclides from 1-H-2 to 160-Upn-398 were created by the program in automatic mode using algorithm (1) based on the formulas of their electronic shells. Manual editing was only required for a few light nuclides. One of the results of the analysis of the nuclide structures obtained by the program is the last shell of the nucleus, which is never shielded by external neutrons in the next shell, despite the presence of vacancies, i.e. it is an analog of the external electronic valence shell.

For example fully filled vacancies for 2-He-10 give the following structure

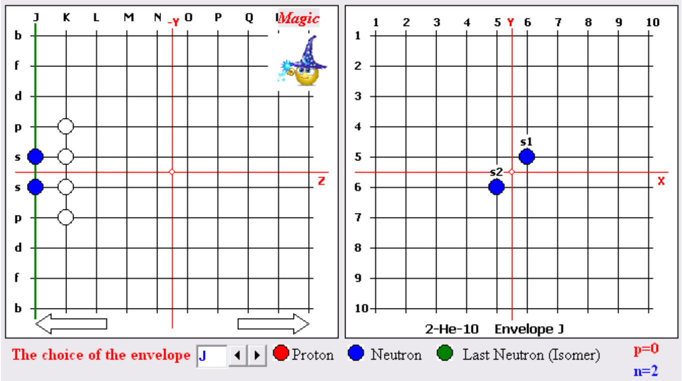


Figure 6.

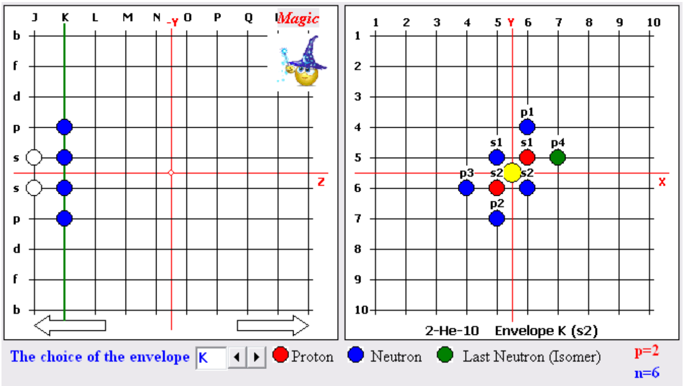


Figure 7.

In the center of the core, the cluster He4 is shown in yellow. the last neutron – filled vacancy Kp4 (Shell K subfolder p4) is shown in Green. Despite the presence of vacancies W1 in the shell L (see in the program), there are no neutrons in it and can not be.

For neutron-surplus nuclei, the addition of neutrons to the main core also occurs according to the algorithm (1). vacancies (if any) W4 are filled first, then W3, and after W2 and W1.

For neutron-deficient nuclei, neutron removal occurs starting from the first shell To in the reverse order of algorithm (1).

In nuclei that are isomers that use the letter "-m" (e.g. 7-N-14-m 8.490 MeV), the neutron occupies the following position according to the algorithm (1).

The proposed model of the structure of atoms allows you to :

1. Calculate the number of inter-nucleon bonds and their distribution along the orthogonal axes;

2. To make calculation of vacancies and to reveal the filling;

3. Determine the conditional center of mass of the core (and the imbalance).

4. Determine the level of centrifugal forces acting on the nucleons.

5. Calculate the specific number of bonds per nucleon.

6. Explain the" magic " of nuclei.

So for a number of nuclides from 20-Ca-35 to 20-Ca-57, the program outputs the following data :

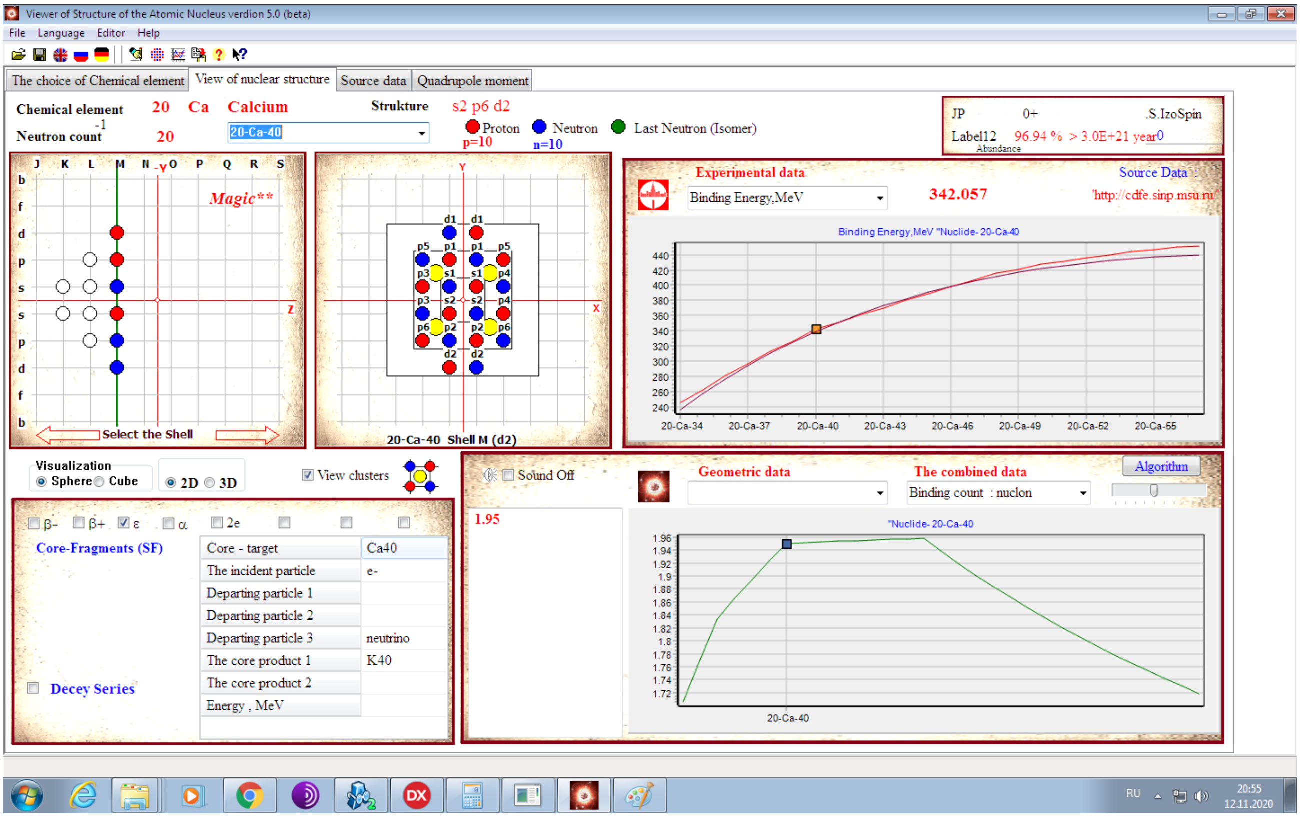


Figure 8. Graph of the ratio of the number of bonds to the number of nucleons for a series of Ca.

For the 20-Ca-40 nuclide, all W3 vacancies are filled, and for the 20-Ca-48 nuclide, all W2 vacancies are filled. That on the graph of the specific quantity the bond\nucleon in the lower part of the figure gives inflection points.

Yellow - cluster centers He4

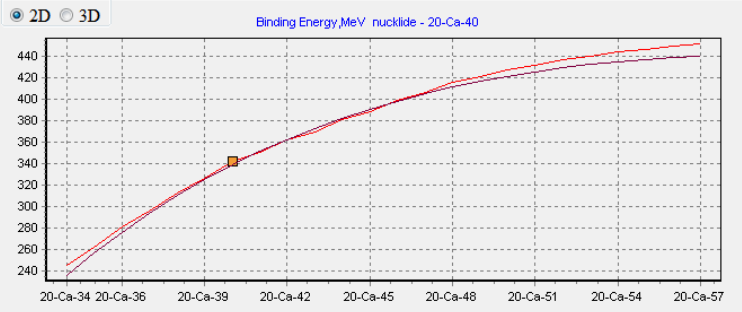


Figure 8.

Graph of the binding energy for the Ca series. Red – table values, black is obtained by the formula of Weizsacker.

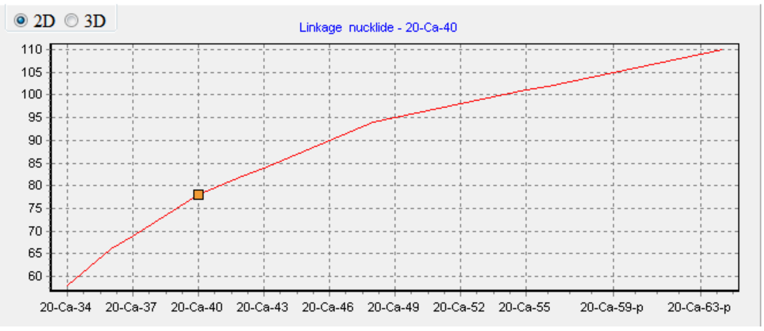


Figure 9.

Graph of the number of links in the Ca series. The last 7 values of the graph are data calculated and added by the program, for undetected nuclides of the range from 20-Ca-58-p to 20-Ca-64-p ("p"-possible). In conventional units.

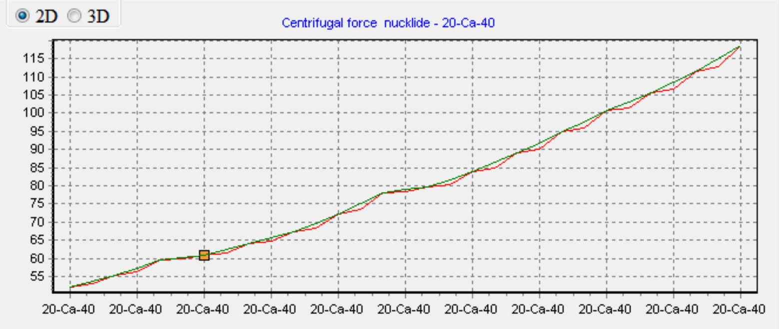


Figure 10.

Graph of the values of the centrifugal force of the Ca series. In conventional units from the axis of rotation.

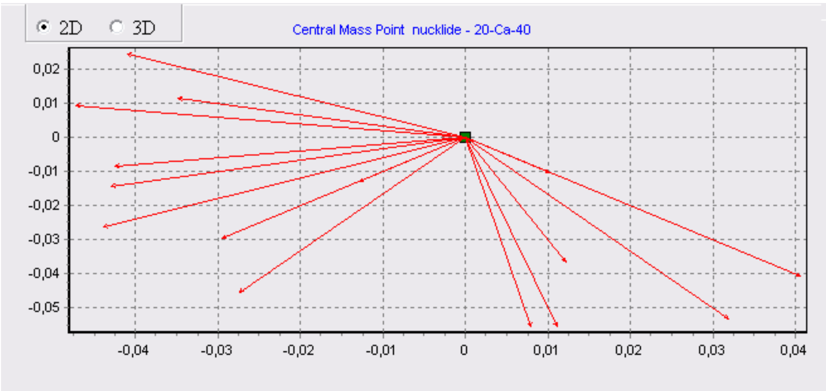


Figure 11.

The position of the conditional center of gravity of the cores of the Ca series. (Author's note – for all nuclides of all chemical elements, the deviation of the center of mass from the conventional axis of rotation of the nucleus, i.e., the imbalance reduces the value of the binding energy.) More symmetrical nuclei have more binding energy than non-symmetrical ones.

All "magic" numbers are obtained from the geometric structure of the nucleus by filling vacancies of a certain rank with neutrons.

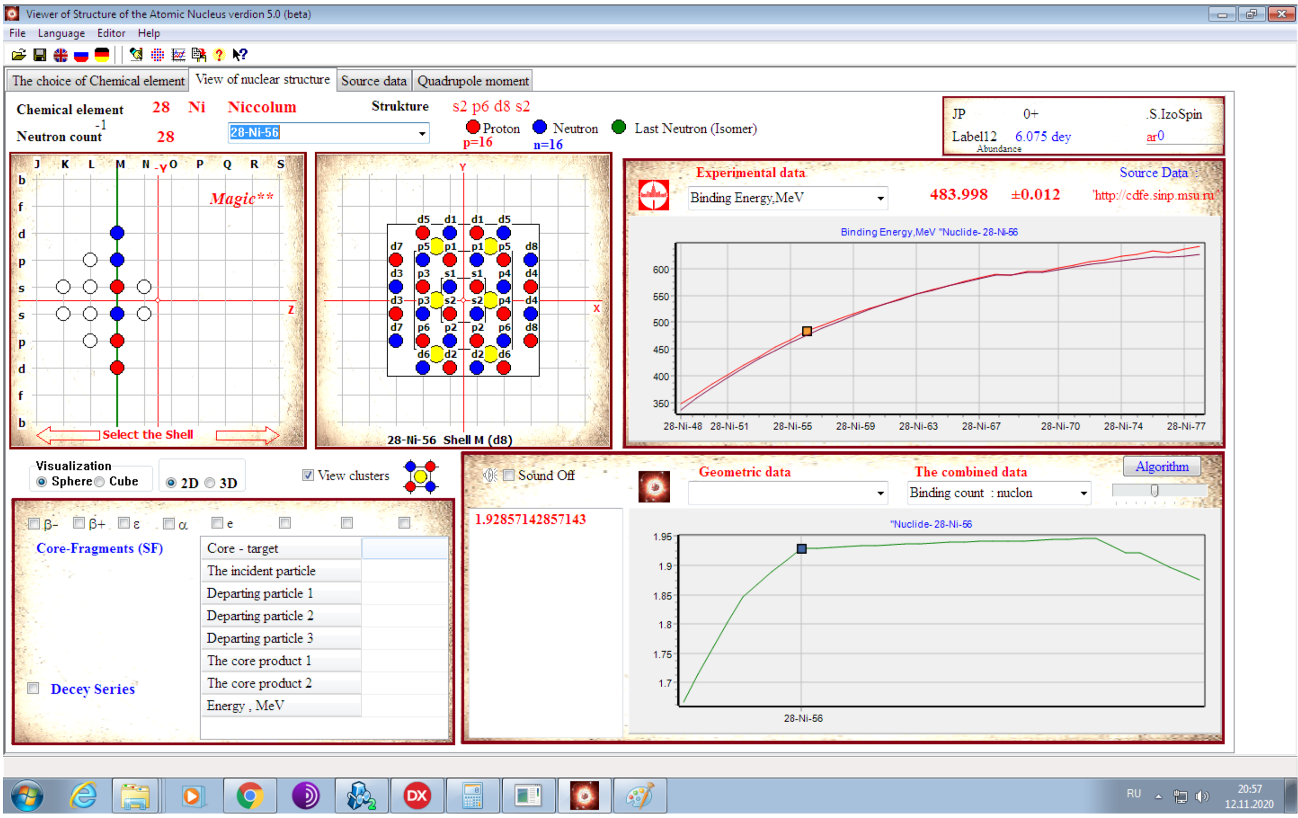


Figure 12.

Illustration for another magic core 28-Ni-56. All W3 vacancies are filled.(Indicated by a red circle)

Filling vacancies gives not only increased communication energy, but also possibly ensures the stability of the cores. For example, filling W2 vacancies gives the only stable nuclide 79-Au-19.

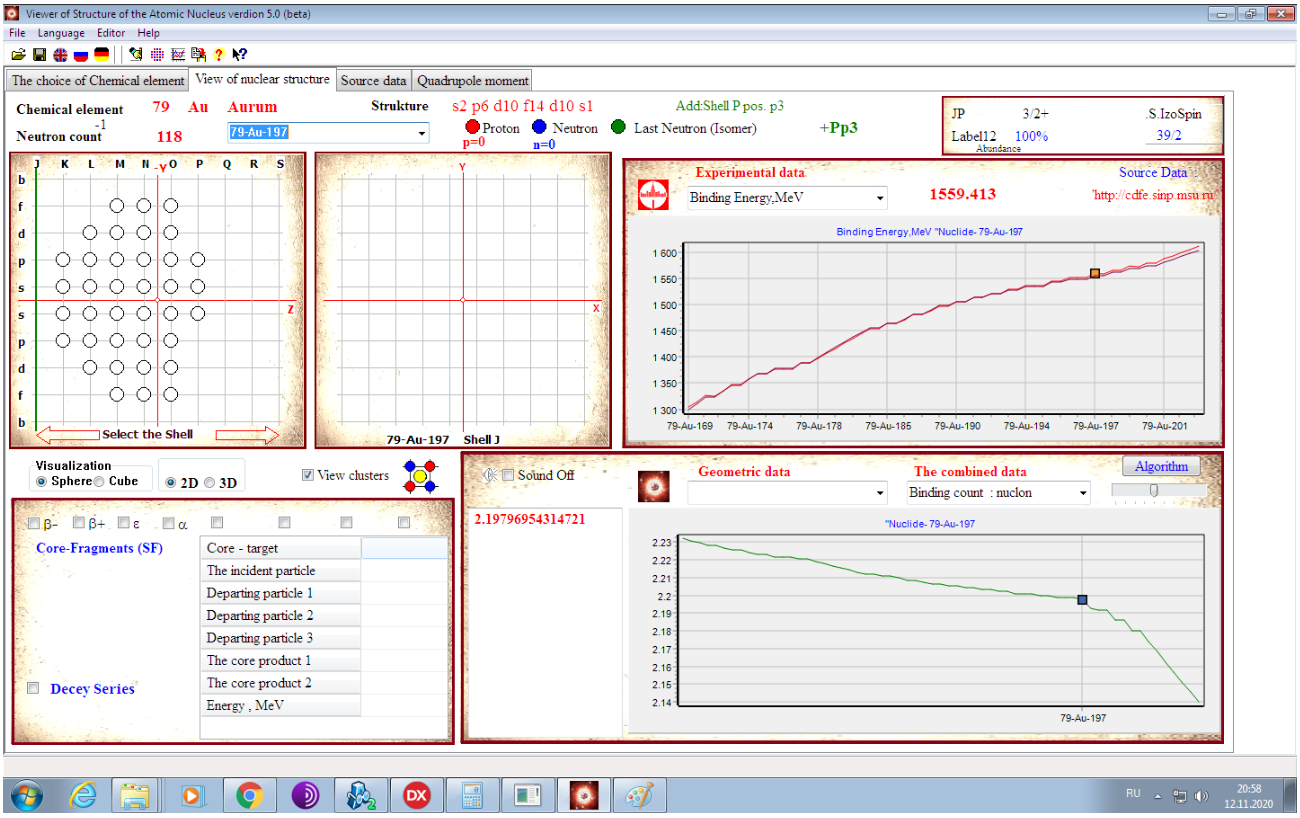


Figure 13.

According to the revealed trend of values of the binding energy of superheavy nuclei, which gives grounds to speak about the "stability island", the author considers the following :

The newly discovered and synthesized Oganeson Nuclide 118-Og-294 has the last filled Qp6 shell.

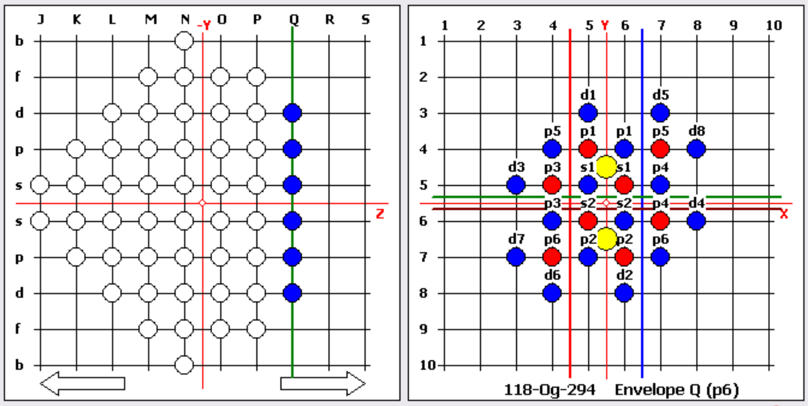


Figure 14.

Further joining of the nucleon pair by the algorithm [1] to the Rs1 position will give the 119th element 119-Uue-296-p. In this case,compared to 118-Og-294,vacancies Nb4,Nb5,Nb6 are released by neutrons, which fill vacancies Rs2, Rp1, Rp3, located closer to the center of the core.

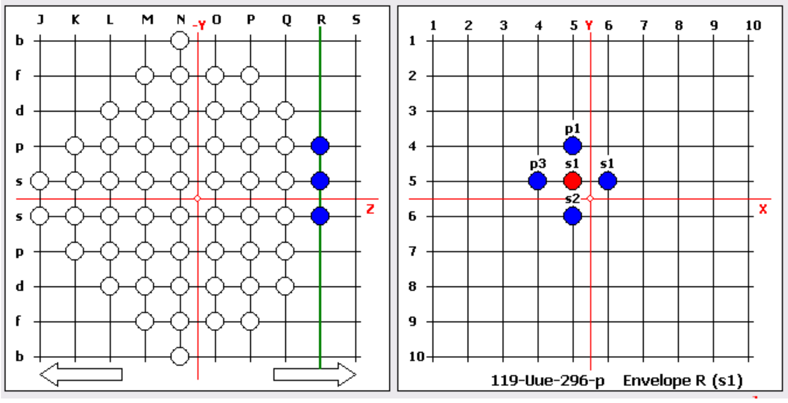


Figure 15.

And filling the Rs2 position with a nucleon pair and adding two more neutrons will give the 120th element 120-Ubn-300-p.

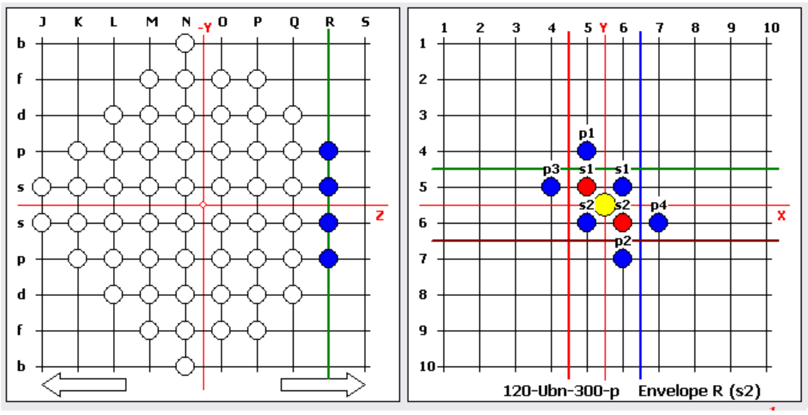


Figure 16.

In comparison with 119-Uue-296-p, the Nb4 vacancy farthest from the core axis is Filled, and the Rp2 and Rp4 vacancies located closer to the core center are filled.

Since the stability of the nuclei is affected by the binding energy, which depends on the number of bonds, the centrifugal force, and the imbalance, we will try to determine these parameters for the last three nuclides.

№	Nuclides	the Count of relations units	Centrifugal strong	uballsnce	the count of bonds on the nucleon unit.
1	118-Og-294	670	797,3908	0	2,2789
2	119-Uue-296-p	676	788,6001	0,024	2,2837
3	120-Ubn-300-p	684	797,057	0	2,28

Table 1.

As you can see, for the 120-Ubn-300-p nuclide, the number of bonds is increased, plus the nucleons added to the shell R are attached closer to the axis of rotation of the core, which gave a smaller increase in centrifugal forces and removed the imbalance, which in principle should give increased binding energy and the lifespan of the core. Thus, the experimentally observed duration of the existence of nuclei as they approach the element 120 "stability island" is explained by the fact that the nucleon pairs and additional neutrons outside the main core fill the farther shells P, Q,R with positions located closer to the axis of rotation of the core.

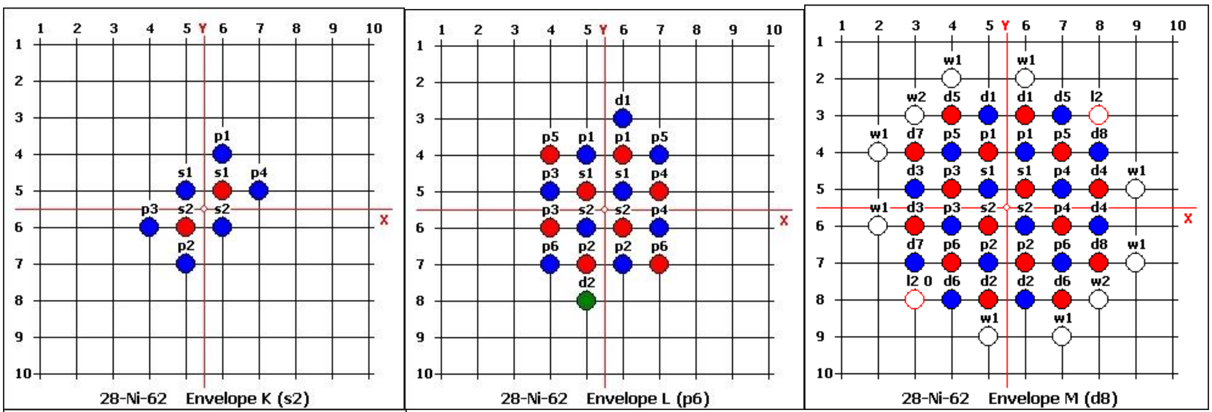
On the 120th element, the "island of stability" ends. Then, from the 121st element, the filling of the OB1 shell position, far from the axis of rotation of the core, begins.

The result obtained by the author as a result of calculations, that the neutron has a weakly negative charge near the nucleus, leads to the conclusion that near the nucleus, the positive Coulomb field of the nucleus is not continuous, but "mesh" with decreasing positive values of the field strength near the neutrons, up to negative values. And, that in these spatial positions, a proton can be attached, which does not need to overcome the high Coulomb threshold of the nucleus.

Thus, there is a theoretical justification for the possibility of Cold Nuclear Fusion (LENR) used in metal hydrides (for example, the a generator).Rossi).

Most likely, H1 protons will attach to spatial positions near the nucleus, where they can form bonds with three or two neutrons. Let's denote such spatial positions by the letter " l " (light) with an index of how many neutrons the proton will be attached to at this point. We will be interested in the points l2 and l3 where a proton joins two or three neutrons.

We analyze the known LENR reaction of a Nickel-Copper pair in the generator A. Russia, based on the Geometric structure of the nuclei of nuclides involved in the LENR reaction.



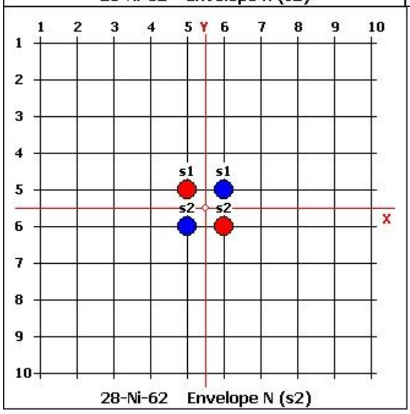
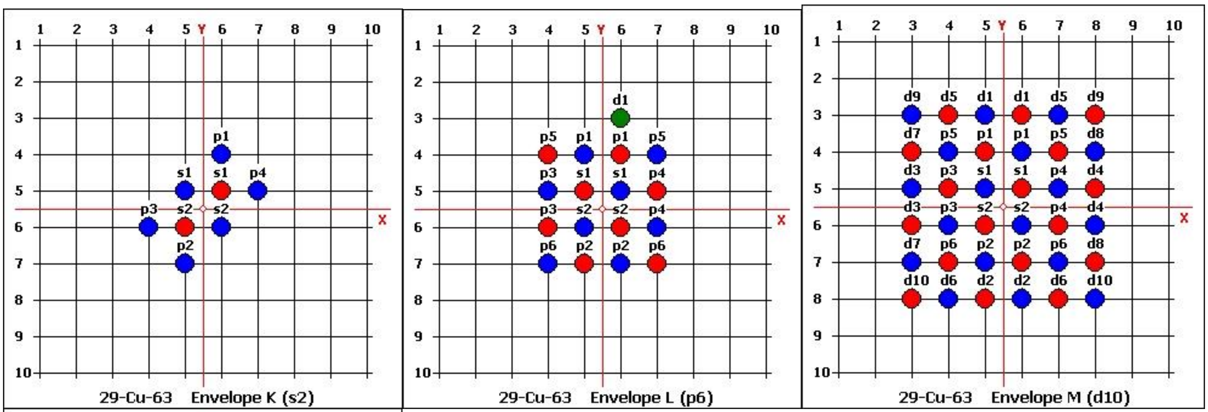


Figure 17,18,19,20 (Structure 28-Ni-62)

There are two L2 positions in the m shell where protons can be attached. These are positions d9, d10 (marked with red circles). Of course, other 28-Ni-62 shells also have l2 and l3 points. But they are closer to the core axis, and the probability of a proton hitting them is lower than in the remote L2 positions of Md9 or Md10.



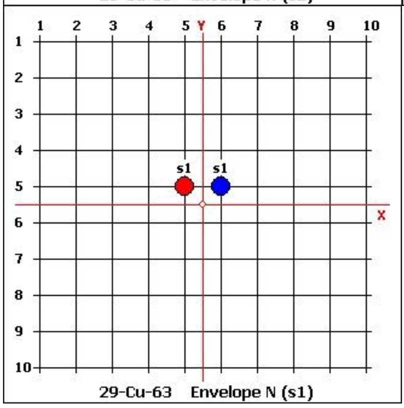


Figure 21, 22, 23,24 (Structure 29-Cu-63)

One or two of the positions d9, d10 and M are joined by one or two protons from the Hydrogen atoms in the crystal lattice.

Possible reactions of nuclides involved in LEN P in the Andrea Rossi generator :
Joining 1 proton :

Ni58	+p	→Cu59	*	→Ni59	**	→Co59				
68,08%		81,5 s		7,6 104 Year		stabile				
Ni60	+p	→Cu61	*	→Ni61	+p	→Cu62	*	→Ni62	+p	→Cu63
26,22%		3,333 h		stabile		9,673 min		stabile		stabile
Ni61	+p	→Cu62	*	→Ni62	+p	→Cu63				
1,14%		9,673 min		stabile		stabile				
Ni62	+p	→Cu63								
3,63%		stabile								
Ni64	+p	→Cu65								
0,93%		Stabile								

* $e^{+} + \nu_e$
** $e^{-} + \tilde{\nu}_e$

Table 2.

Joining of 2 protons :

Ni58	+2p	→Cu60	*	→Ni60	+p	→Cu61	*	→Ni61	+p	→Cu62	*	→Ni62	+p	→Cu63
68,08%		23,7 min		stabile		3,333 h		stabile		9,673 min		stabile		stabile
Ni60	+2p	→Cu62	*	→Ni62	+p	→Cu63								
26,22%		9,673 min		stabile		stabile								
Ni61	+2p	→Cu63												
1,14%		stabile												
Ni62	+2p	→Cu64	*	→Ni64	+p	→Cu65								
3,63%		stabile		0,93%		stabile								
Ni64	+2p	→Cu66	*	→Zn66										
0,93%				stabile										

Table 3.

It is logical to assume that the e+ positrons formed in the reactions * annihilate with free electrons flowing through the crystal lattice of the material, due to the applied current. The gamma quanta obtained during annihilation are absorbed both by Ni and Cu atoms and by the walls of the chamber in which they occur, causing their temperature to rise.

We analyze changes in the number of bonds in nuclides during the LENR Li-Cu reaction.

Raw nuclides	Lincs	type of reaction	Product nuclides	Lincs	Add lincs
Ni58	112	+p	→Co59	113	1
Ni58	112	+2p	→Cu63	121	9
Ni60	116	+p	→Cu63	121	5
Ni60	116	+2p	→Cu63	121	5
Ni61	118	+p	→Cu63	121	3
Ni61	118	+2p	→Cu63	121	3
Ni62	120	+p	→Cu63	121	1
Ni62	120	+2p	→Cu65	125	5
Ni64	124	+p	→Cu65	125	1
Ni64	124	+2p	→Zn66	128	4

Table4.

Indeed, the reaction of Li58 adds 9 bonds to Cu63.

Based on the above analysis of the addition of a proton to the nucleus in the LENR reactions, we can conclude that similarly, in addition to Lithium and the already known Nickel-Copper pair, another element can be used as a source material, having a filled sub-shell with the value d8 or d9.

№	Raw nuclides	Structure	Product nuclides	Added links
1	27-Co-59	Ks2;Lp6;Md8;Ns1	28-Ni-60	3
2	45-Rh-103	Ks2;Lp6;Md10;Nd8;Os1	46-Pd-104	5
3	78-Pt-196	Ks2;Lp6;Md10;Nf14;Od9;Ps1	79-Au-197	5

Table 4.

Of the possible LENR pairs, the reaction is interesting - Cobalt-Nickel. Moreover, 27-Co-59 is the only stable nuclide and will be involved in the reaction with the entire volume.

Also, according to the author, it is noteworthy that the reaction of Platinum – Gold. Both the source and resulting nuclides are stable. (By the way, the stability of 79-Au-197 is provided by fully filled vacancies W2.) And the resulting product is several times more expensive than raw materials.

Also, the nuclide 78-Pt-196 has an increased value of l3=32 (marked by a vertical line on the graph) compared to other stable nuclides of Platinum.

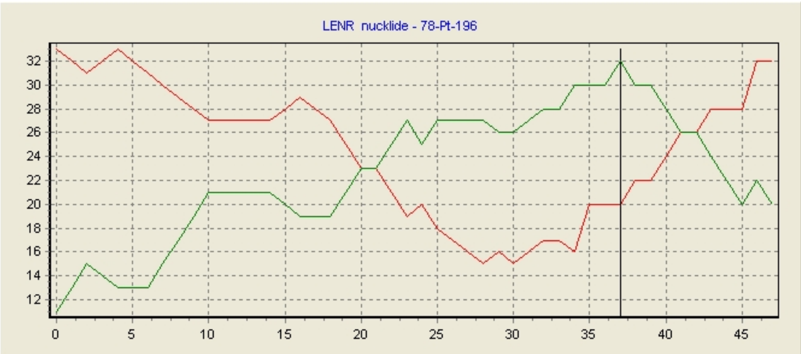


Figure 25.

L2,l3 values for the Platinum range.

Perhaps all nuclides containing positions l2,l3 on the outer side of the core are capable of CHC reactions. For example, a stable Zr90 has 14 positions l2, and 16 positions l3. Filling one position with a proton will give the nuclide Nb91. At the same time, 5 bonds are added, and the binding energy increases by only 5.2 MeV.

References :

1. Boldov I. A. "Geometric Theory of the structure of matter and space" Intercollegiate collection of scientific papers Special issue "Actual problems of natural science" Vol. 1, Samara Aerospace University 2005 70-92.