

# Three Laws of Nuclear Shapes

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March 31, 2026 revision 808

## Abstract

The Static Nucleus Theory of the Face-Armored Cubic Lattice introduces laws of nature. Carbon, and heavier elements, center on a cubic stack of protons and neutrons. All chemical elements from carbon to manganese have exactly two protons in the cube. Outside of the cube, protons make lines of protons that touch. The cubic core law results in the nuclear surface having a hexagonal close-pack shape. That surface shape has small gaps between nucleons, so matter survives for centuries. The law of lines of protons results in a small number of long lines existing in heavy elements. Each line has two ends. Chemical bonds usually start at the ends of proton lines. The chemical valence limit of 8 is due to there being up to 8 ends of lines of protons, for all stable elements. Electronegativity is related to nuclear shapes. The bi-modal mass distribution of fission fragments is due to the shape of uranium. The water bond angle is easily calculated from the oxygen nuclear shape. The average binding energy per nucleon graph has slope changes because light elements use two-layer cubes and heavier elements have three-layer cubes at their cores. See the periodic table of nuclear shapes.

## Summary

The atomic theory had electrons with uncertain positions. There was a nucleus with protons and neutrons that were organized in places that were too small to measure. I started this work to propose theoretical positions for the protons and neutrons in all elements. That was done because science did not have authoritative statements on that. Iron was evaluated first. This paper reveals laws of nature that define the major causes of nuclear shapes and charge distributions. By tabulating positions of all protons and neutrons in all elements, the sciences of chemistry, quantum information theory, and magnetism are given mechanistic reasons for many phenomena. This Static Nucleus Theory shows that form fits function at the femtometer scale. Iron was found to have two rings of protons, like a solenoid electromagnet.

## The Static Nucleus Theory of the Face-Armored Cubic Lattice

Three laws of physics are promoted here. The first law is about carbon and heavier chemical elements: there is a cubic stack of protons and neutrons in the center of the nucleus. A two-layer cube is for light elements and a three-layer cube is for the centers of the nuclei of most elements. The second law is for carbon to manganese: there are exactly two protons in the elements' cubic zones. After manganese, a transition occurs to eight protons in the center of a three-layer cube. The third law is that protons touch protons and make lines of protons outside of the cube. Geometric reasoning is used instead of the algebra of energy. There are 19 rules of nuclear shapes [1] in my book about *Charge Distributions on the Nuclei*.

The cubic core law results in the nuclear surfaces having a hexagonal close-pack shape (HCP). The HCP surface exists on most elements, so they could survive for a trillion years (Fig. 1). The gaps between nucleons in the cube are large, making that area vulnerable during collisions. The HCP outer

surfaces have small gaps, so some invulnerability occurs for most of the chemical elements. The gaps between nucleons in a cube have about five times the area of an HCP gap (see Extended Data, Fig. 6). The law of lines of protons results in a small number of long lines existing in heavy elements. Each line has two ends. The chemical valence limit of 8 is due to there being a maximum of 8 ends of lines of protons in 117 elements out of 118 elements. Technetium has 10 ends of proton lines. Chemical bonds usually start at the ends of proton lines and at salient bends in rings of protons. Digital models of all elements are available in a 229 kilobyte text file in the Extended Data. The models have xyz coordinates of 17,000 protons and neutrons. The file name is nuclei\_118\_O.txt [2]. The oxygen coordinates are shown next to Fig. 4 in this paper. Fig. 1 shows the Fe and Nd elemental constructions. The cubes have three layers of nucleons. The cubes have symmetrical allocations of protons. The white protons form symmetrical lines of protons in pyramids to armor the six faces of each cube. The lines of protons in the pyramids join to make rings of protons. Nd is shown with a prominent white proton at the top of the image, which distinguishes it from Ce, the foundation element of Nd. That precise location of that proton empowers Nd to enhance Fe magnets by smoothing the ring shape. This is believed to be the correct theory of *Charge Distributions on the Nuclei* [1].

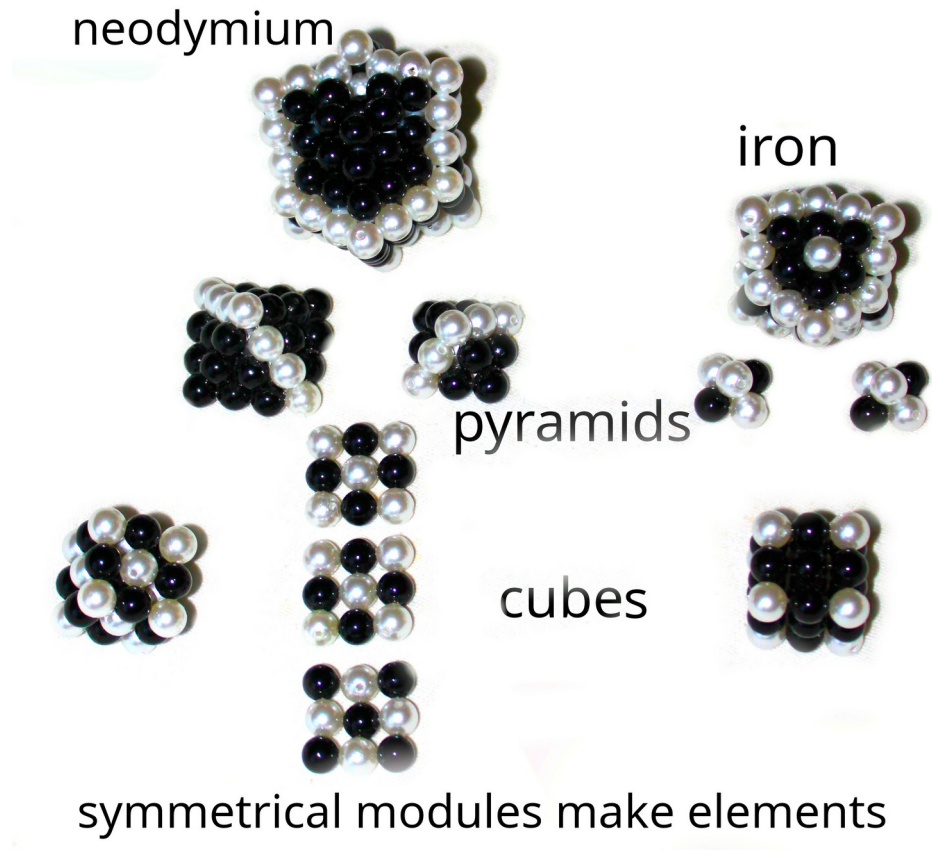


Figure 1: Cubic cores in Nd and Fe, using three layers of dark neutrons and white protons. The right side has the Fe cube-module and two pyramid modules separated to illustrate the internal structure of the ferromagnetic paragon. To armor the cube's six faces, six pyramids with two layers nestle into the cube, which has three layers. On the left side, Nd has a proton ring like Fe, but no axial proton is seen on the nuclear surface.

Iron is ferromagnetic because it has two coaxial rings of protons. See [3], paper number one. At the right of Fig. 1, iron is made from a cube-3 and six pyramids. Each pyramid is like Li-5 that bends into a

face of the cube. The nucleons nestle into gaps. Symmetry is common for proton allocations in the cube and in the pyramids. At the left of Fig. 1 the neodymium nucleus is shown, based on the cerium foundation element. Neodymium has 2 more protons than cerium. One is at the top of Nd in the figure. Cerium has two pyramid-4 and four pyramid-3 modules to cover the cube's faces.

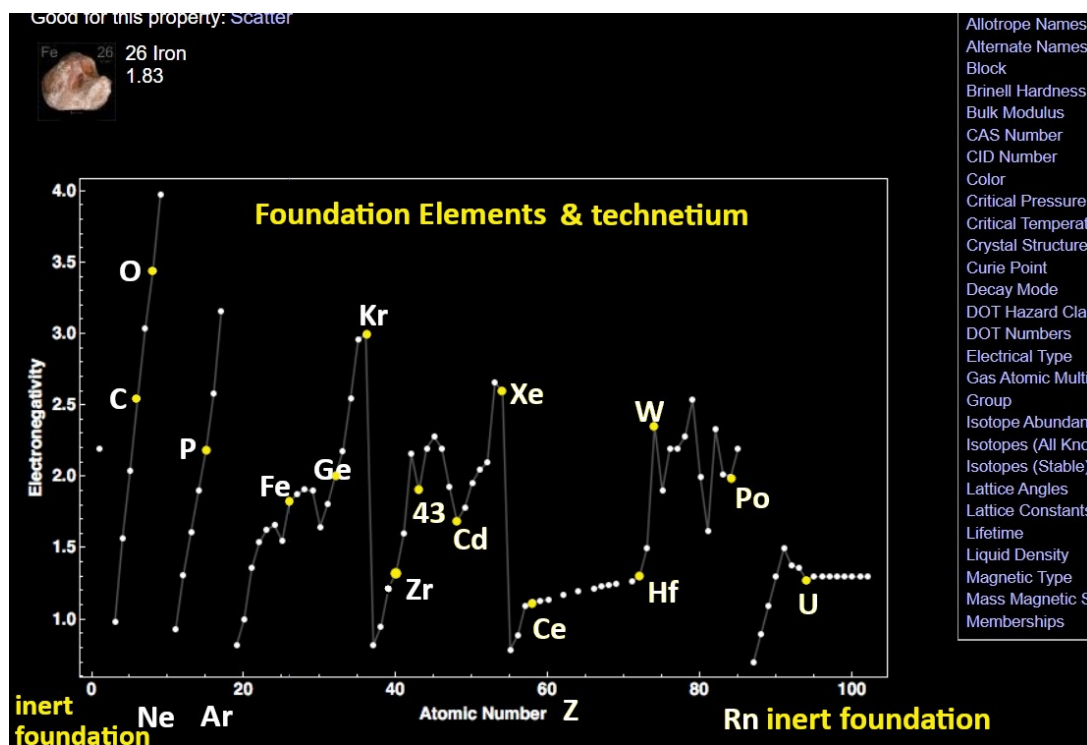


Figure 2: Chemical electronegativity mapped to foundation elements. The vertical axis is electronegativity from 0.5 to 4. The horizontal axis is the atomic number Z. I have added the chemical symbols for foundation elements near the electronegativity graph. At the bottom, I noted the inert gases, with zero electronegativity. All inert gases are foundation elements. That is because a thorough assignment of six pyramids to six faces of a cube resulted in the inert gases being foundations.

Fig. 2 shows a graph of the electronegativities of 100 chemical elements [4]. The foundation elements are labeled (C, O, Ne, P, Ar, Fe, Ge, Kr, Zr, Cd, Xe, Ce, Hf, W, Po, Rn, and U). Notice how the heavy foundation elements occur where the slope changes. This is evidence that this theory is the correct theory of nuclear shapes. Each foundation element is simply a cube with six pyramids. The cubes are armored by the six piles of nucleons.

Progress in chemistry can occur with knowledge of positive charge distributions. The electronegativity in this essay is in a class of words including valence, chemical potential, oxidation number, and coordination number. After foundation element U, the subsequent elements have a similar electronegativity. This type of trend occurs for groups of elements. The foundation elements Cd, Xe, Ce, Hf, and W in Fig. 2 start a series of similar electronegativities. The Lanthanides from cerium to lutetium are bracketed by foundation elements Ce and Hf. Future research for chemistry is expected to be a fertile task to fit chemical functions to nuclear forms. The number of protons in a line might define part of the electronegativity, by subtracting or adding.

## Uranium

The bi-modal mass distribution of uranium fission fragments is due to the shape of U-234. The curve in Fig. 3 is a sketch of the standard results from experiments. The heavy fragment has up to 159 nucleons and the small fragment has as little as 75. The cube has 27 nucleons, and it can join the big piece or the small piece. That is why the graph has a gap of 27 nucleons for A, the mass number. The nucleon count of the big pyramid plus the cube adds up to 159. The nucleon count of the other five pyramids adds up to 75. That persuades the author of the accuracy of this theory for heavy elements and light elements.

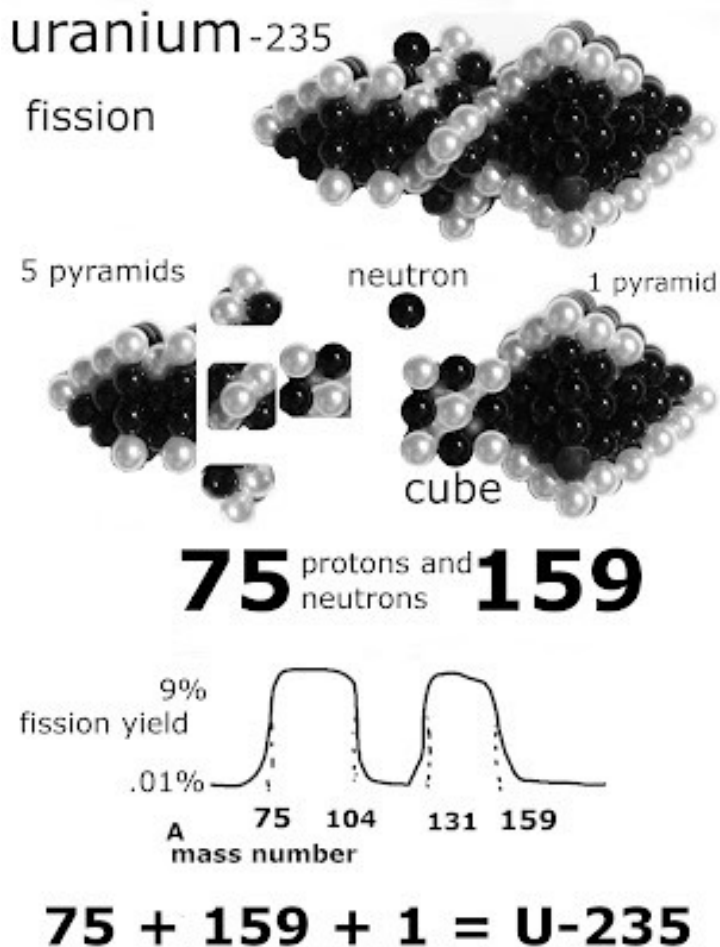


Figure 3: Bi-modal masses of fragments of uranium fission. The graph has a vertical axis of fission yield from 0.01% to 9% yield of chemical elements' atoms. The horizontal axis is the mass number of the elements that were experimentally found as fragments of uranium. A mode of small mass fragment yield was found and also, many heavier elements were yielded with masses that had a mode from 131 to 159 nucleons mass number element. A cube has 27 nucleons for U-235. The two mass modes are separated by 27 nucleons. Each mode is about 28 nucleons wide. I conclude that the cube can be in the small fragment or in the big fragment after fission, and that creates the bi-modal graph of mass number.

## Tables for chemistry

Chemists can use Tables 1 to 4 on my website page of goals [5]. Table 1 gives the number of proton lines in each element up to yttrium. Each proton line has two ends. The number of **ends of proton lines** is tabulated next to **valence**. Both numbers range from 0 to 8, except Tc, with ten ends of proton lines. Table 2 gives the number of proton lines in each element from zirconium to gold. Table 3 gives the

number of proton lines in each element from mercury to americium. Table 4 gives the bond fulcrum vectors for elements up to scandium. That is the direction to the proton at the end from the previous proton location. All elements' nucleon coordinates are publicly available.

The oxygen coordinates are shown, below. The water bond angle calculation used models like Fig. 4. Chemistry can use the four tables in [5] to see data about bond directions for ends of proton lines. I calculated the vectors for all light elements. They are named The Bond-Fulcrum Vectors. The proton lines on the oxygen nucleus make a double helix. The water bond angle of  $\arccos(-1/4)$  is easily calculated from the oxygen nuclear shape. All elements' digital nuclear models can get proton-line bond-fulcrum vectors to calculate bond angles.

Oxygen-17

Ar -1 1 1

S 1 1 1

S -1 -1 1

S 1 -1 1

S -1 1 -1

S 1 1 -1

S -1 -1 -1

*Ar 1 -1 -1*

Ar -2.41 0 0

**Ar 0 4.41 0**

*Ar 2.41 0 0*

Ar 0 -2.41 0

Ar -1 3 1

S 1 3 1

S -1 3 -1

**Ar 1 3 -1**

S 0 0 2.41

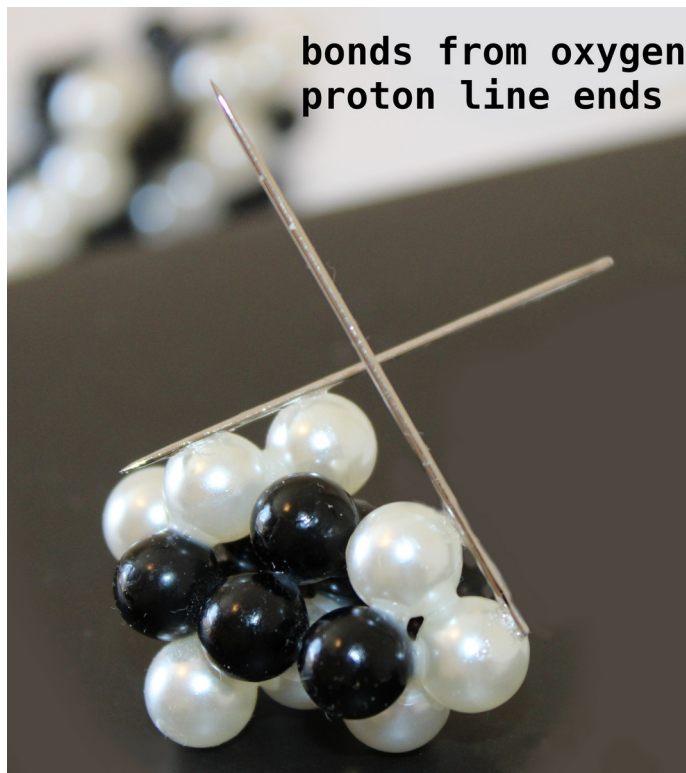


Figure 4: Water bond angle, based on directions of proton line ends of the oxygen nucleus. White beads represent protons and black beads are for neutrons in the oxygen-17 model nucleus. Two more images of O are in the Extended Data Fig. 7 and 8 to show the double helix of proton lines. The numbers at the left are nucleon xyz coordinates for the oxygen-17 isotope. Vector geometry was used [3] to calculate the  $H_2O$  bond angle of  $\arccos(-1/4) = 104.48$  degrees. Oxygen nucleon coordinates use proton code Ar and neutron code S for import to Blender CAD using xyz format. The bold coordinates are for one end of a proton line. The italic coordinates are for two protons on a different end of a different proton line.

### Average binding energy per nucleon

The average binding energy per nucleon graph-slope-changes are the result of light elements using two-layer cubes and heavier elements having three-layer cubes at their cores (Fig. 5). Those slopes are also affected by the existence of 19 foundation elements that are the basis for 90 incremental elements. A foundation element only has a cube, with its six faces armored by six pyramids of nucleons. Each

incremental element is based on a foundation element with additional nucleons on the outer surfaces of the foundation.

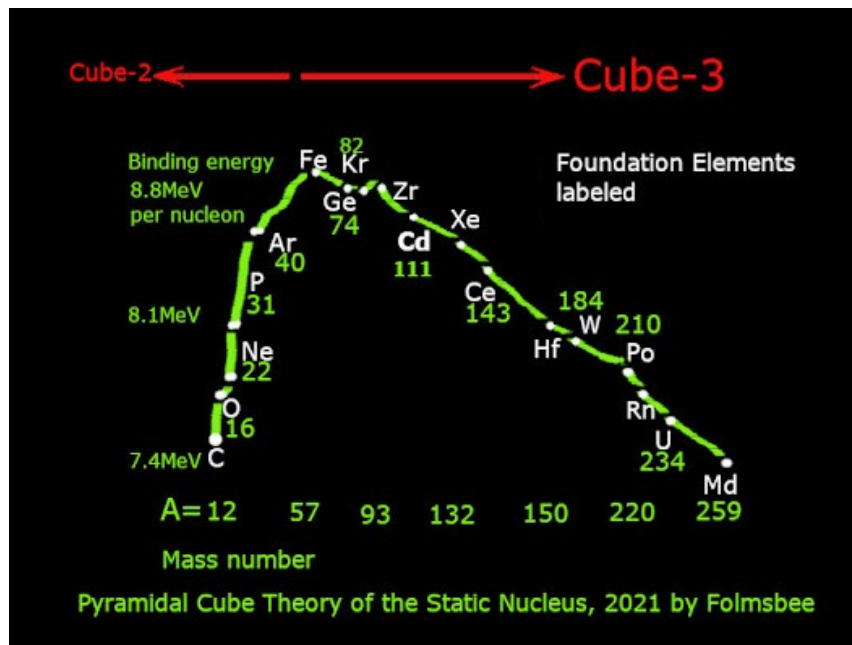


Figure 5: Binding energy curve slope changes versus mass numbers of foundation elements. This curve has a vertical axis for mega electron-volts over a small range. The horizontal axis lists the chemical elements' mass numbers A. I added the foundation element symbols. A slope-change happens where a foundation element takes over from the incremental elements that were based on the adjacent foundation element.

Fig. 5 is about nuclear binding energy. The sketch is from <https://www.britannica.com/science/nuclear-binding-energy>, with added notes. Light element foundation elements have a porous shape. Starting with iron, a smooth nuclear shape exists for heavy foundation elements. That is why the slope is positive from carbon to manganese and the slope is negative after iron.

Iron and argon are foundation elements. Iron has a smooth shape, and argon has a porous shape (Fig. 12, Extended Data). The periodic table of nuclear shapes shows that porosity. Adding a nucleon to Ar increases the average binding energy because the new nucleon sits in a trench. Treat the strong nuclear force as a liquid draining into each nucleon. The deep trench will capture a nucleon into Ar better than Fe, which has shallow pits. The hydrodynamic force on a nucleon on a shallow gap on the Fe surface will be a smaller force than in a deep Ar trench.

### The Periodic Table of Nuclear Shapes

A periodic table of nuclear shapes is ready for your evaluation [8]. From that table, one may identify oblate nuclei, prolate elements, and those elements with the pear-shaped octupole nuclear deformation shapes. One other researcher [6] already predicted a shape of carbon that is the same as mine, except for the allocation of proton positions among neutrons. He used a cubic core in 2017, the same year I first used a cubic core. That author did not continue using cubes for heavier elements. The periodic table of nuclear high resolution shapes is in Fig. 9 of the Extended Data.

The red circles represent the nucleons in the cubes in a schematic plan of nucleons in the sphere stacking theory. The black circles represent nucleons in the pyramids, while omitting the front and rear pyramids for clarity. Those two pyramids would have the same shape as the two side pyramids. Blue circles are protons added to make 90 incremental elements. Notice that the 19 foundation elements do not have blue circles, foundation elements only have a cube and six pyramids. Digital models of all elements are ready [2] for you to import into the Blender computer aided design tool. The argon plan-view in the periodic table shows the porous nature of that foundation element's nucleus. Compare that to germanium, with its smooth shape. Fig. 10 uses color codes like in the periodic table to feature N, Fe, and Pm nuclear plans. Those three elements are some of the simplest. A cube of one size has six pyramids with the next smaller size. Nitrogen has a cube-2 and six pyramid-1 modules. Iron has a cube-3 and six pyramid-2 modules. Promethium has a cube-4 and six pyramid-3 modules. Those simplest elements reveal the paradigms for explosive chemicals, magnetic materials, and radioactive elements. Fig. 11 shows why the nitrogen molecule has a triple bond: N has three salient, symmetrical proton locations.

## Discussion

The rapid development of this Static Nucleus Theory of the Face-Armored Cubic Lattice was due to the wise choice of iron to be the first element to be evaluated. Iron was chosen during May, 2017 because its properties are the most spectacular. The ferromagnetic property is easy to measure and it has a profound capability, like gravity, to force motions to occur at long distances. The hardness of iron is excellent. The stability of its nucleus, which prevents fission and fusion under most conditions, was inspirational. Iron makes sparks, when struck, more than most elements. This combination of properties motivated me to use iron as the best element to begin making laws of nuclear shapes that would then be applied to all 118 elements. Success was immediate. There are several ambiguities in the results. For example, the helix in oxygen's proton line could go clockwise or the opposite way. (See Extended Data Fig. 7 and 8 for oxygen double helix of two proton lines.)

The future research can use iron as one in a class of elements with proton rings. Memory metal nitinol, magnetic memory, and nerve memory can use nickel, iron and iodine, where rings of protons guide electrons to pass through the nucleus. Room temperature quantum effects, that use neutron spins, are shared by this proposed class of materials [3]. AC signaling in tin [9] was used by other researchers for a quantum experiment at low temperatures (alternating current). Iodine's nucleus is like tin. I-127 is hoped to have room-temperature functionality for some biological quantum effects. Iron uses DC (direct current) to make a memory of a magnetic pole. Fig. 13 in the Extended Data shows a model with wooden flux lines from 24 protons penetrating the Fe nucleus and diverging to remote electrons. Electrons sequentially pass through a nucleus and emerge from the other side to change a north pole to become south. The Barkhausen effect makes audible clicks when a bar magnet swaps poles, and maybe each electron makes a single click when it passes through the Fe nucleus. See Fig. 13 in the Extended Data to see flux confluence in a magnetized ferromagnetic nucleus [3]. The confluence phenomenon is shared by ferromagnetic alloys, nitinol alloy, and tin quantum devices, in theory. In the tiny nuclear core, flux lines from protons to electrons touch each other without room to bond. This enables nuclear spins to be communicated to electrons [9] to be measured.

Correct-seeming results come easily with a correct theory. Correct-seeming results come rarely with an incorrect theory. Other researchers did not begin with iron. They usually planned to start with the smallest elements and use insights from that work to make rules for all chemical elements' nuclear shapes. For examples, the helium cluster theory, the quark theory, the magic number theory, and the

spherical nucleus theories did not deliver credible ideas that applied to heavy elements' nuclear shapes. Those efforts lacked structural complexities that could lead to a theory that could be applied to heavy elements. Iron is a mid-sized nucleus and the discovery that it has two coaxial rings of protons allowed quick recognition of correctness (Fig. 1). The two proton rings are like the metal wire coils in a large solenoid electromagnet. The current in the proton ring is called a loyalty current due to electron current involvement.

Elements from C to Mn have a two-layer cube with 2 protons and 6 neutrons. Elements from Fe to Tn mostly have a three-layer cube with 27 nucleons. The four-layer cube, with 64 nucleons, makes four radioactive elements like promethium and technetium. That four-layer cube is unstable because the center point is a vacuum and the stacks of nucleons are relatively tall. In light elements, the 2 s electrons are central in atomic chemistry. The 2 protons in the two-layer cube correspond to those famous electrons. That is one piece of evidence, among many [4], that convinced me that I discovered a precise and plausible theory of nuclear shapes.

## Conclusion

The correct description of the shape of the nucleus is introduced only one time in history. The three laws that were announced together here, for the first time in a corporate journal, provide connectedness to the hierarchy of matter. A mechanistic line of flux from a proton to one electron is theoretically durable. Rings of protons use AC and DC concepts for chemical elements to gather electrons to pass through certain nuclei. The origin of life may be the memory in a neutron spin, that steers and stores successful traits. That ancient memory primitive may be in iodine today, for us to learn.

## References

[1] Folmsbee, my 535 page book, *Charge Distributions on the Nuclei*, has the construction details of all 118 chemical elements' nuclei, self-published on Amazon, (2022)

[2] Folmsbee, my website is nuclear-data.com, for coordinates of nucleons, 229K bytes, (2025)

[3] Folmsbee, paper 1 on iron <https://nuclear-data.com/papers/> paper 7 on oxygen bond, papers 14 to 17 on quantum memory (2018 - 2025)

[4] ([periodictable.com/Properties/A/Electronegativity.html](https://periodictable.com/Properties/A/Electronegativity.html)).

[5] Table 4 of chemical bond fulcrum vectors up to scandium, Tables of nuclear rings and lines <https://nuclear-data.com/2024/02/10/goals/>

[6] Bihari, nuclear shape-making attempts using round magnets and geometric ideas. Gabor Bihari "Geometric Models of Atomic Nuclei", World Journal of Nuclear Science and Technology, Volume 7, Issue 3, Figure 13 has carbon with a central 2x2x2 cube of nucleons. I did not see that paper until years after my May 25, 2017 discovery of a plausible theory of the shape of the iron nucleus. (July, 2017)

[7] Folmsbee, Evidence Summary supporting this theory, <https://pyramidalcube.blogspot.com/p/evidence.html> (2021)

[8] Folmsbee, Periodic Table, <https://pyramidalcube.blogspot.com/p/periodic-table.html>  
2048 x 1418 pixels or Extended Data file 3418 x 2340 pixels

[9] “Control of Solid-State Nuclear Spin Qubits Using an Electron Spin-1/2” Hans K.C. Beukers, Christopher Waas, Matteo Pasini , Hendrik B. van Ommen , Zarije Ademi, Mariagrazia Iuliano , Nina Codreanu , Julia M. Brevoord , Tim Turan , Tim H. Taminiu, and Ronald Hanson, QuTech and Kavli Institute of Nanoscience, Delft University of Technology <https://journals.aps.org/prx/pdf/10.1103/PhysRevX.15.021011>, (11 April 2025)

# Extended Data

“Three Laws of Nuclear Shapes” rev. 708 Alan Folmsbee, March 31, 2026

Link needed to text file of 17,000 nucleon coordinates. File name nuclei\_118\_o.txt  
Size 243Kbyte.

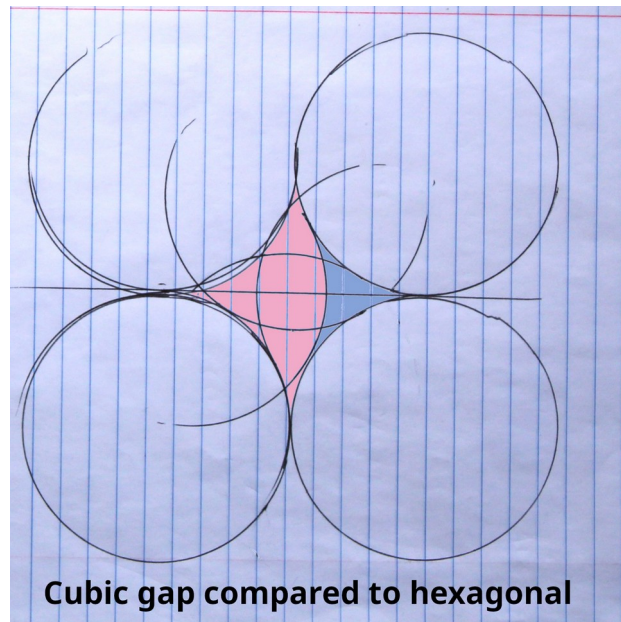


Fig. 6: the hexagonal close-pack gap is blue. A gap in a cubic stack of nucleons is red plus blue.

A foundation element has a simple description: it has a cube and six pyramids without other nucleons. Light elements, like oxygen, have shapes that are compared to heavy nuclei, like tungsten. Both nuclei have a big end and a small end. But the surface of W is smooth HCP. The surface of oxygen has cubic gaps and the discrete shapes vary abruptly, compared to W and its neighboring elements on the periodic table. A cubic gap is shown in Fig. 6 next to a gap from an HCP lattice. This is used to imagine why Fig. 5 has its shapes for average binding energy per nucleon. The binding energy graph is treated as a hydrodynamic situation. Pressures on nucleons near a gap cause the nucleons to approach a fusing nucleus. The hexagonal gaps will exert less force on the approaching particle than would a cubic gap.

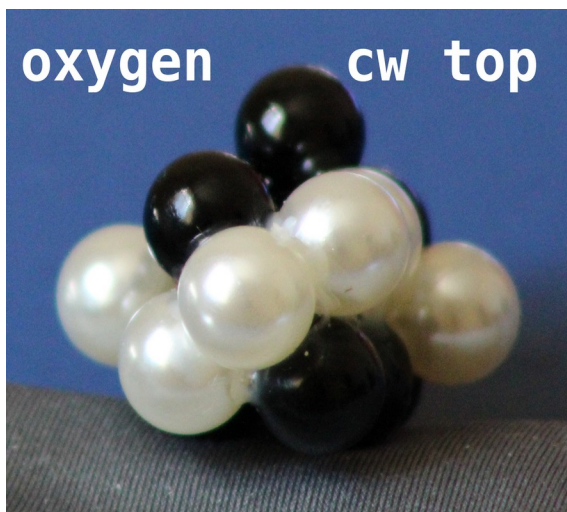


Figure 7: oxygen helical line of five protons on right, clockwise twist

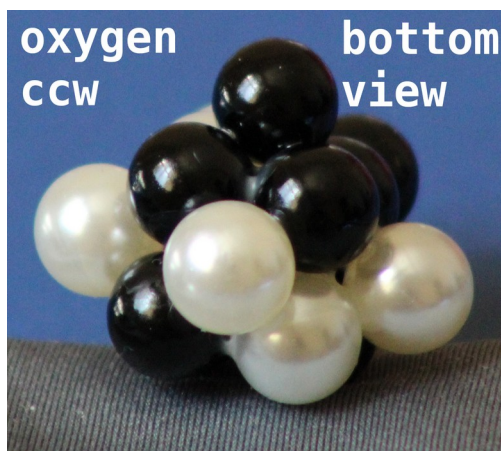
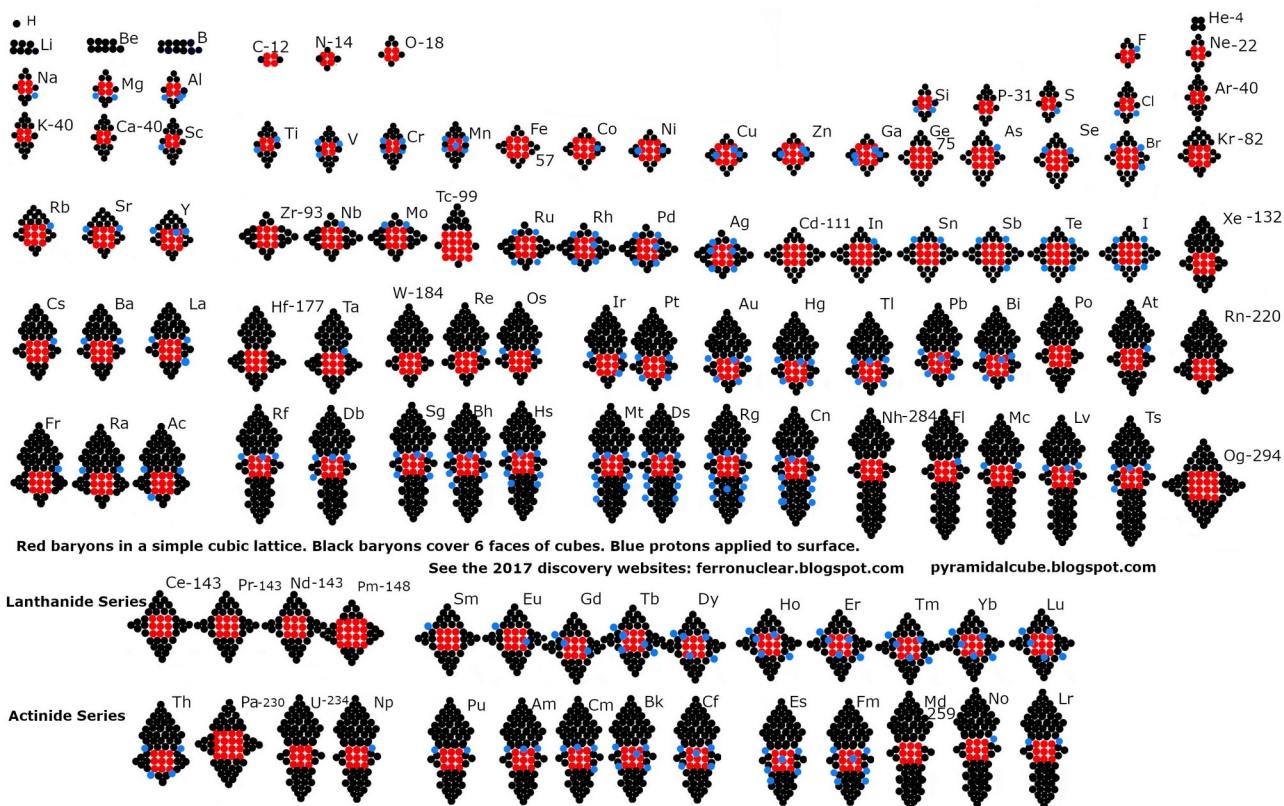


Figure 8: three-proton line on the right makes a counter-clockwise helical shape, from this angl



## Periodic Table of Nuclear Silhouettes

Alan Charles Folmsbee  
Hartford, Connecticut, March 7, 2022

Figure 9: Periodic Table 3418 x 2340 pixels. Red cubes, black pyramids, blue protons on incremental elements. A foundation element only has a cube and six piles that armor the faces for The Static Nucleus Theory of the Face-Armored Cubic Lattice.

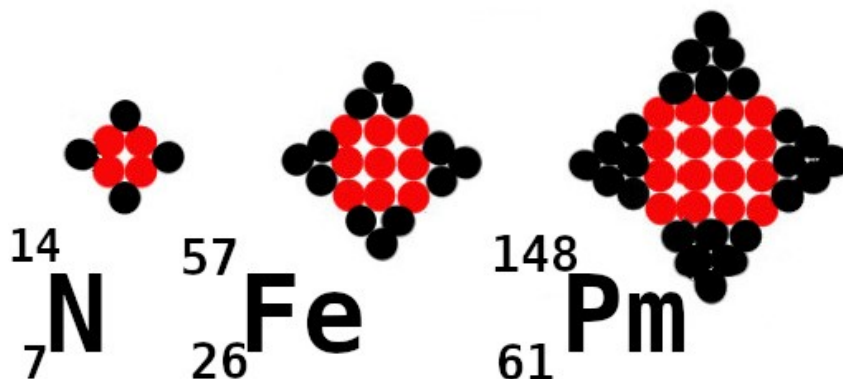


Figure 10: The three simplest stacks give the paradigms of the explosive chemical, the magnetic material, and the radioactive element. Form fits function. Red cubic stack. Black nested stacks of nucleons. Alan Folmsbee March 25, 2026.

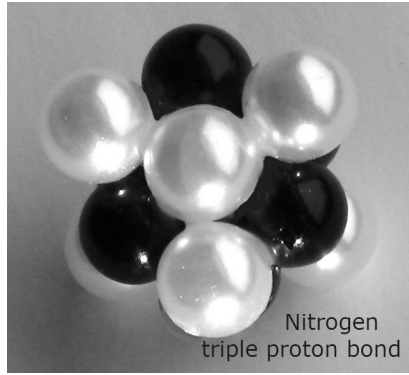


Figure 11: nitrogen triple bond fulcrum, form fits function, four protons start three directions of bond



Figure 12: Clockwise from right, argon, copper, silicon, iron. Nucleons are all gray except copper which has black neutrons.

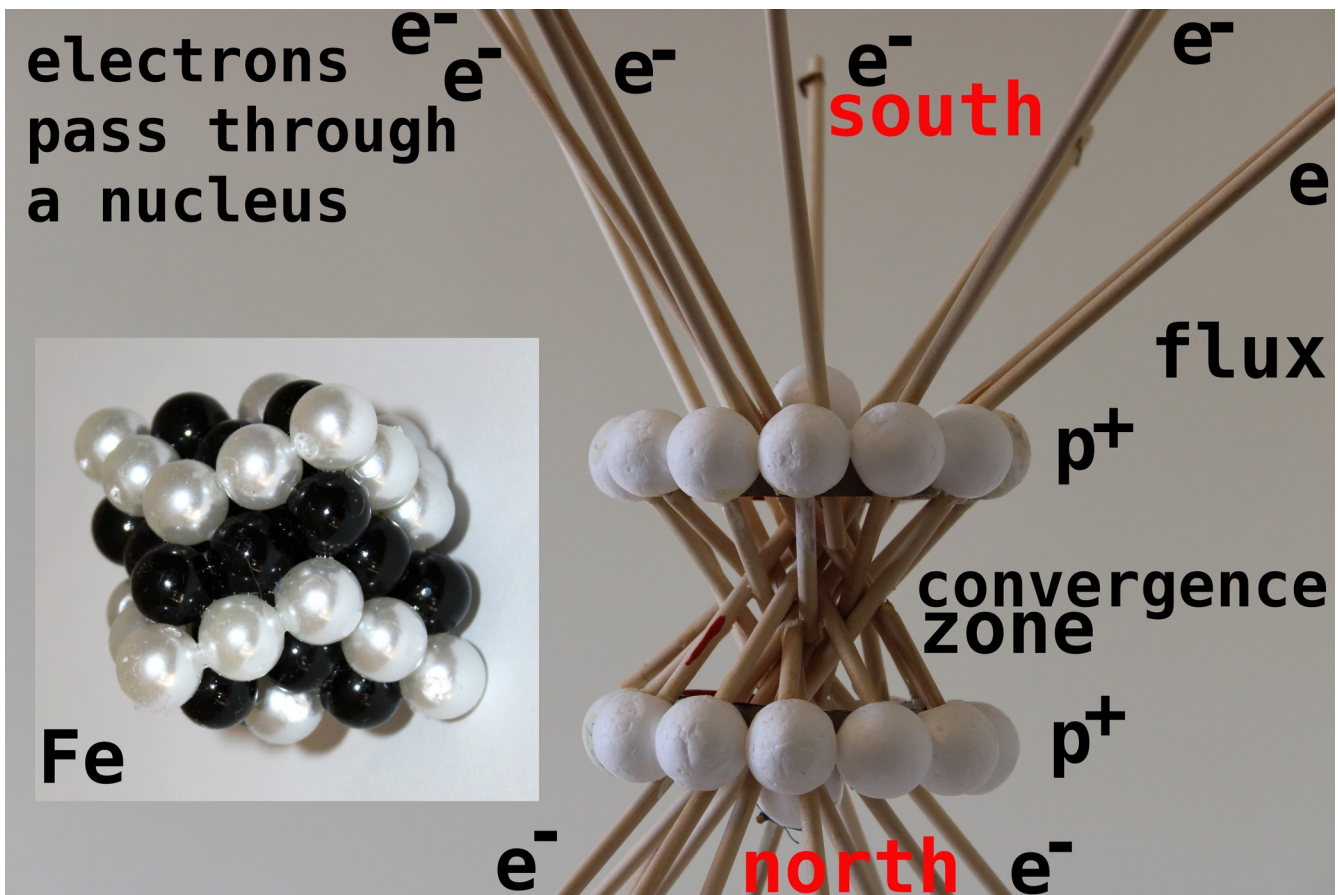


Figure 13: simplified ferromagnetic phenomenon using a Weber magnetic flux visualization

The flux confluence zone in Fig. 13 allows electrons spins to influence neutron spins and vice versa.

## Methods in Theoretical Physics

Alan Folmsbee March 31, 2026 rev. 708

“Three Laws of Nuclear Shapes”

## Fourteen Research Choices

Fourteen sequential research choices resulted in my Static Nucleus Theory of May 25, 2017.

First, I decided to try to make progress in physics by announcing a law or shape from nature (1990). I expected that several Laws had not been noticed, yet. Some phenomena were right in front of my eyes, but nobody noticed them.

Second, nuclear shapes needed to be proposed, to fill the blank pages of the books on chemical elements.

Third, Fe was chosen as the first element to be evaluated because its ferromagnetic property is so easy to measure and magnetism has been thoroughly studied by past scientists (2017).

Fourth, a static nucleus theory was chosen because other researchers had tried using many dynamic nuclear ideas. Spherical nucleons were chosen to be stacked to have the Z and A values according to standard tables for chemical elements (atomic number and mass number).

Fifth, crystallographic arrangements would be attempted with cubic, random, or hexagonal close-pack arrangements of spherical nucleons for nuclei. Sixth, experiments were done using a random collection of 26 protons and 31 neutron beads. That showed that protons must touch protons because there are not enough neutrons to isolate them.

Seventh decision: protons can make lines of multiple protons. Try not to branch.

Eighth, the core of Fe was modeled using a cubic stacking of proton and neutron spheres. The six faces of the cube were planned to be covered by piles of nucleons.

Ninth, the cubic core would stack a 3x3x3 lattice of nucleons because Fe-57 would get 27 nucleons in the core. (8 in the core seemed too small and 64 in the core, too large).

Tenth, simple arithmetic revealed how plausible it is to use 6 piles of protons and neutrons (nucleons) to cover the 6 faces of the cube. The mass number was calculated to be precisely appropriate, using the cube and six pyramids:

$$A = 57 = 27 + 6(N)$$

where N is 5 nucleons to cover each face with a pyramidal stack.

Eleventh, the integer results from that calculation gave me hope that this is an excellent candidate structure for the Fe nucleus. So, I continued the research. The atomic number was calculated, and the answer fit together like a key in a lock.

$$Z = 26 = 8 + 6(3)$$

Twelfth, symmetry and electrostatic repulsion were chosen for allocating protons in the cube. The core protons are at the 8 corners of the cube (2017).

Thirteenth, the maximum distance from a neutron to a proton is chosen to be neutron diameter. That ensures that neutrons do not decay quickly. Protons feed neutrons (2021).

Fourteenth Decision, 19 foundation elements simply have pyramids on six faces of the cube. 90 incremental elements add nucleons to the surfaces of chosen foundations (2022).

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## Method: The Evidence Hierarchy & Sequence of Elements' Evaluations

Iron was chosen in 2017 as the first element to be evaluated as a method to show the shape of a nucleus. Other researchers started with the smallest elements, wrongly expecting that that is better than starting with a medium sized element with outstanding properties.

Iron-57

Cobalt and nickel were next, to see similarity to Fe, the paragon.

Copper and manganese were done to see a dissimilarity with Fe.

Gadolinium was done to see similarity to Fe, the paragon.

All 118 elements needed to be visualized for ring shapes.

The three elements shaped the most like Fe were Co, Ni, and Gd!

Chromium is the only element that is anti-ferromagnetic, so I evaluated the nuclear shape.

Cr has two rings that overlap 25%. That is the paradigm for anti-ferromagnetism.

C-14, N-14, O-18, Ar, Mn, W, U

Fe

Co

Ni

Cu

Mn

Gd (2017)

Ce

C-12

O-17

Ne, Ar, Kr, Xe all inert gasses are foundation elements (2017)

Mn

Cr

U (2018)

N-14, Pm, Tc, Pa, Og

Cd error was fixed after a search for thoroughness of foundation elements (2022).