# A Novel Interpretation of Nucleus and Nuclear Force

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【Abstract】
Objective: This study aims to reanalyze the essence of nuclear force and elucidate the genuine structure of atomic nuclei.
Method: We employ an approach that encompasses the examination of nuclear mass loss, sub-nucleon constituents and dynamic nucleus behavior.
Conclusion: Our findings challenge the conventional view of nuclear forces as fundamental forces and propose a dynamic crystal-like structure for atomic nuclei.
Keywords: Deuteron, Nuclear Force, Subproton, Neutron, Dynamic Nucleus, Deuteron Crystal

In the realm of theoretical physics, amidst the intricate and elegant theories like the Standard Model, questions and reflections persist within the scientific community. Notably, Professor Wang Lingjun at the University of Tennessee has been an outspoken critic and has recently articulated his concerns in the paper titled "Proposal to the Chinese Physics Community" [1].

It is worth mentioning that Professor Li Zhengdao (Tsung-Dao Lee) was among the first to voice subtle criticisms of particle physics. In his book "Fields and Particles," Professor Li made a thought-provoking comment on the Standard Model of unified gauge theory. He pointed out that this theory demands about 20 parameters, encompassing various mass values and weak decay angles. Such a profusion of parameters raised the question of whether our existing theories are fundamentally phenomenological. This paper explores the implications of this critique.

The requirement of about 20 free-fitting parameters in a scientific theory raises significant questions about its validity. This number of parameters far exceeds what is typically considered a sound and robust scientific theory. To put this into perspective, it is reminiscent of John von Neumann's quip that "With four parameters, I can fit an elephant, and with five, I can make him wiggle his trunk."

The presence of 20 free parameters in the Standard Model leads to remarkable, almost fantastical consequences. These parameters, while seemingly arbitrary, manage to account for a wide array of phenomena, from neutrino oscillations to quark oscillations or mixing, Cabibbo or CKM Mixing, and even dark matter and dark energy. This proliferation of parameters transforms scientific theory into an intricate mathematical puzzle.

Critically, any scientist versed in statistics and mathematical modeling would recognize that a theory relying on 20 free-fitting parameters is fundamentally flawed and lacks scientific rigor. Professor Li Zhengdao's comment, "Who has ever heard of it," underscores the incredulity that such a theory could be regarded as a fundamental description of nature.

Professor Li Zhengdao's critique of the Standard Model strikes at the heart of its credibility. This critique is not contingent on a deep understanding of the theory's intricacies or a background in quantum field theory; it hinges on the common-sense understanding that a theory laden with 20 free parameters is, at best, a mathematical abstraction.

To provide a more intuitive understanding, we take one recent paper as an example. The paper is by Wu Yueliang, a professor at the University of Chinese Academy of Sciences. Wu is also a researcher at the Asia-Pacific International Center for Theoretical Physics and the Institute of Theoretical Physics of the Chinese Academy of Sciences. In this paper Wu proposed what' s being referred to as a breakthrough in the quest to uncover Einstein's unified field theory: super unified field theory【2】

$$\boxed{\bar{\partial}_{\mathrm{N}} \mathbf{G}_{\mathbf{A}}^{\mathbf{MN}} = \mathbf{J}_{\mathbf{A}}^{\mathbf{M}}}$$

Gauge Gravity Equation of Super Gravity Field in Super Unified Field Theory

$$\begin{aligned} I_H \equiv & \int [d\hat{x}] \chi \mathfrak{L} = \int [d\hat{x}] \chi \phi^{D_h-4} \{ \hat{\chi}^{\mathrm{MN}} \frac{1}{2} \bar{\Psi} \Gamma_{\mathrm{A}} \chi_{\mathrm{M}}^{\mathrm{A}} (i\partial_{\mathrm{N}} + g_h \mathcal{A}_{\mathrm{N}}) \Psi \\ & - \frac{1}{4} (\tilde{\chi}_{\mathrm{ABA'B'}}^{\mathrm{MNM'N'}} \mathcal{F}_{\mathrm{MN}}^{\mathrm{AB}} \mathcal{F}_{\mathrm{M'N'}}^{\mathrm{A'B'}} + \hat{\chi}^{\mathrm{MM'}} \hat{\chi}^{\mathrm{NN'}} \mathcal{W}_{\mathrm{MN}} \mathcal{W}_{\mathrm{M'N'}}) \\ & + \alpha_E \phi^2 \frac{1}{4} \tilde{\chi}_{\mathrm{AA'}}^{\mathrm{MNM'N'}} \mathbf{G}_{\mathrm{MN}}^{\mathrm{A}} \mathbf{G}_{\mathrm{M'N'}}^{\mathrm{A'}} + \frac{1}{2} \hat{\chi}^{\mathrm{MN}} d_{\mathrm{M}} \phi d_{\mathrm{N}} \phi - \beta_E \phi^4 \} \\ & + 2\alpha_E g_h \partial_{\mathrm{M}} (\chi \phi^{D_h-2} \mathcal{A}_{\mathrm{N}}^{\mathrm{NM}}), \end{aligned}$$

Gauge Invariant Super Unified Field Theory Action Under the Framework of Gravity Quantum Field Theory

$$\begin{aligned} I_H \equiv & \int [d\hat{x}] \mathfrak{L} = \int [d\hat{x}] \chi \phi^{D_h-4} \{ \bar{\Psi} \Gamma^{\mathrm{M}} [i\partial_{\mathrm{M}} + (\Xi_{\mathrm{M}}^{\mathrm{PQ}} + g_h \mathbf{A}_{\mathrm{M}}^{\mathrm{PQ}}) \frac{1}{2} \Sigma_{\mathrm{PQ}}] \Psi \\ & - \frac{1}{4} (\tilde{\chi}^{\mathrm{MNM'N'PQP'Q'}} \mathbf{F}_{\mathrm{MNPQ}} \mathbf{F}_{\mathrm{M'N'P'Q'}} - \hat{\chi}^{\mathrm{MM'}} \hat{\chi}^{\mathrm{NN'}} \mathcal{W}_{\mathrm{MN}} \mathcal{W}_{\mathrm{M'N'}}) \\ & + \alpha_E ( \phi^2 \mathcal{R} - (D_h - 1)(D_h - 2) \partial_{\mathrm{M}} \phi \partial^{\mathrm{M}} \phi ) + \frac{1}{2} \hat{\chi}^{\mathrm{MN}} d_{\mathrm{M}} \phi d_{\mathrm{N}} \phi - \beta_E \phi^4 \} \\ & + 2\alpha_E g_h \partial_{\mathrm{M}} (\chi \phi^{D_h-2} \mathbf{A}_{\mathrm{N}}^{\mathrm{NM}}), \end{aligned}$$

General Coordinate Invariant Super Unified Field Theory Action Derived from Gravity Gauge Geometrical Parity

The large number of parameters directly contradicts with the principle that "the universe is simple and elegant". This principle has been recognized and pursued by many scientists such as Einstein, illustrated by his quote "nature itself is concise, orderly, highly generalized, harmonious and unified, and governed by extremely beautiful and simple laws".

If one aspires to unravel the enigmas within the realms of particle physics and atomic nuclei, the Standard Model will assuredly captivate and perplex the inquirer with its complex, profound and brilliant mathematical formulations. In addition to often making up for the flaws by refitting parameters or theories, it also shies away from the fact that the Standard Model itself is shaken up within its own system by the discovery of neutrio' s rest mass which has been proved decisively. Moreover, the scientific spirit was abandoned with infinite amplification of the decay time of "free protons" to $10^{31\sim36}$ years. To put that into perspective, the age of Earth has been estimated to be on the magnitude of

$10^{10}$ years. There have been many unanswered questions, such as why protons are so stable, while the neutrons' lifetime is less than $10^3$ seconds, given that neutrons and protons are both composed of three "quarks", which have never been observed in the laboratory, bound by the strong force between quarks. And by contrast, all other microscopic particles (gluons, mesons, etc. except photons) have a lifetime of only $10^{-10}$~$10^{-8}$ seconds (a few seconds for the W boson). Not a single case of free proton decay has been observed, while it can be easily observed in the nucleus.

Furthermore, if charge-neutral photons mediate the electromagnetic force, how do they distinguish between opposite charges and same charges to generate attraction and repulsion respectively? Similarly, how can "gluons", which have not been directly observed so far, mediating strong force and "gravitons", which also have not been directly observed, mediating gravitation produce only attractive force but no repulsive force?

**In fact, the fault lies in the structure of the atomic nucleus and the so-called strong and weak forces!**

We propose the following theory: there are no neutrons and protons in the nucleus, and there is no so-called "fundamental force", the strong force (nuclear force) or the weak force.

We start our analysis with deuterons (D), which can be split into protons and neutrons under strong γ-ray irradiation (energy ≥ 2.22 MeV). On the contrary, when protons and neutrons form deuterons, they will release 2.22 MeV energy in the form of photons. The reaction is:

$$p+n \ —D+\gamma$$

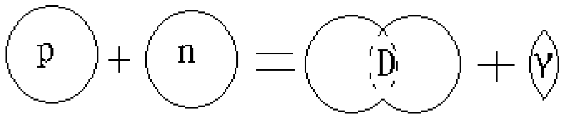
The Standard Model believes that there is a strong force (nuclear force) in the nucleus. To disassemble the nucleus, one needs to overcome the nuclear force with huge energy. The implication is that if the deuteron is like two strong magnets attracting together, and this attracting force is the strong force.

If it is indeed the case, then this "force" appears to have "negative mass", because that the mass of a deuteron is less than the sum of mass of a proton and a neutron.

With the same analogy, there is attraction force between two magnets $m_1$ and $m_2$. And it takes work or energy to separate them. So will their respective masses increase if they are separated? Do they lose mass when they're close together?

The answers are of course no. However, exceptional things still happened, and the "strong force" was artificially "created".

Apparently, scientists imagined deuterium nuclei as two independently attracted spheres, when in reality they are not. See below.




Schematic diagram of proton and neutron synthesis of deuteron

In the deuteron (in fact, all nuclei are the same), there are actually no independent protons and neutrons that ″maintain the original mass″ (and then attract each other by nuclear force). There are only ″quasi-neutrons″ and ″quasi-protons″ whose masses are smaller than those of free protons and neutrons. And the deficient mass radiates as gamma rays.

The specific process of the above-mentioned deuterium synthesis is actually as following:

High-energy protons and neutrons collide and ″submerge″ when they are extremely close to each other—that is, the overlapping state in the above diagram. That is actually like hydrogen molecular ions——$H_2^+$ ions (two H atoms share an electron cloud, the radius is reduced). However the force is different. Although the $H_2^+$ ions can exist stably, just like the deuterium nuclei, there are no molecules or ions with more than 2 hydrogen atoms such as $H_3$. This does not agree with the existence of the nucleus of high nucleon numbers as the 3-118 elements.

Regarding how to unlock the mechanism, in fact, scientists have already discovered in the process of stellar evolution that there are many mechanisms for neutrino pairs to be produced in the late stage of stellar evolution, such as the Yucca process, neutrino bremsstrahlung, photogenerated neutrino process, electron pair annihilation neutrino process and the plasmon decay neutrino process, etc. All processes are actually ultimately just one of the two cases, a neutron or a photon decays into a neutrino pair:

$$n/\gamma \rightarrow + \bar{\upsilon} + \upsilon$$

This decay phenomenon of photons, which can also decay into positron-electron pairs, is well known in the scientific community.

However, this process in neutrons has not been directly observed. It is obviously true for both the Yucca process and the neutrino bremsstrahlung process! Therefore neutrons can “decay” into gamma photons.

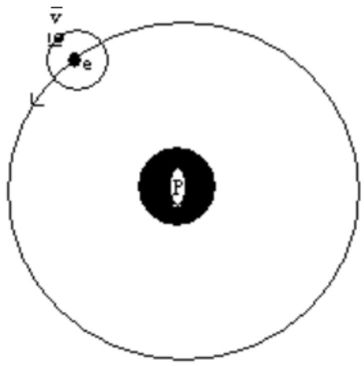
Moreover, the generated neutrino pairs obviously cannot be electron-type at the beginning, but neutron-type neutrino pairs or inert neutrinos, which is generally considered unlikely to exist.

Coming back to the neutron structure. Is it really composed of three quarks as stated in modern particle physics? Just like the proton is also composed of three quarks? In fact, although this kind of understanding is mainstream, it cannot withstand scrutiny at all! As mentioned above, protons and neutrons, which are both composed of three quarks, have infinitely different lifetimes.

In fact, neutrons are not so complicated, and protons are so simple, but atomic nuclei are not so simple.

From the perspective of any microscopic nuclear reaction related to neutrons and protons, neutrons are actually unstable structures composed of protons, electrons and antineutrinos, which explains that they can decay! Their lifetime is at least in the order of $10^3$ seconds, which is within the range of normal observation of human beings. The others whose half-lives are in the order of $10^{-10}$~$10^{-8}$ seconds, strictly speaking, are kind of resonant states. And they cannot be regarded as elementary particles. At most they can be regarded as transition states. The half-life of real material elements should be greater than that of neutrons!

The structure of the atomic nucleus can be analyzed and deducted with the knowledge of the decay products of neutrons. Simply put, based on the result of neutron free decay, neutrons are unstable structures composed of protons, electrons and antineutrinos! The neutron structure diagram is as following:




Schematic diagram of neutron structure

Let's analyze the following process of producing neutrons: $\bar{\upsilon}_e + p \rightarrow n + e^+$. This reaction is enough to reveal the internal structure of neutrons.

when high energy antineutrino $\bar{\upsilon}_e$ collides with p, $\bar{\upsilon}_e$ hits the edge of the proton (certainly below the Fermi surface of the electron) with high energy. The huge energy (kinetic energy excited as excitons) disintegrates into positive and negative electrons, of which the positrons are instantly ejected, and the electrons are captured by the protons. At the same time, the speed of $\bar{\upsilon}_e$ drops suddenly, and it instantly becomes an "inert antineutrino" $\bar{\upsilon}_n$——In fact, due to decelerating, part of the kinetic energy has been transformed into mass. $\bar{\upsilon}_n$ is then captured by the electrons, which have been captured by the proton earlier (because the magnetic force is dominant). Then both $\bar{\upsilon}_e$ and the electron surround the proton together. The electron and the surrounding inert neutrino actually form a new particle, a $W^-$ boson, as scientists call it. Therefore the scientific community can observe the $W^- \rightarrow e + \upsilon_e$ decay reaction!

It is well known that although neutrinos are charge neutral, they have magnetic moments and can interact with magnetic fields. Therefore they can exist in the orbit of electrons whose spins generate magnetic fields.

However, we have not estimated the mass of inert neutrinos yet. Since the mass of neutrons, protons and electrons are 1.6749, 1.6726 and 0.0009109 x $10^{-27}$ kg respectively, it can be deducted that the mass of the inert neutrino is about 0.0013891 x $10^{-27}$ kg, which is 52% larger than the mass of electrons!

The instability of the electron itself (thermal motion) and the influence of gravity lead to serious instability of the system. Therefore the half-life of $W^-$ is only about 3 seconds. Of course, $W^-$ particles are not as outrageous as scientists say. Their mass is claimed to be a hundred times that of protons, and at the same time they can decay into electrons and neutrinos, with the mass of electrons being only 1/1836 of protons.

However, in the neutron regime, $W^-$ half-life is much longer than 3 seconds. Once they form a whole system with protons, due to the influences of the strong Coulomb force and the proton's magnetic field, the electrons tend to be stable (spin stability, revolution stability). And the neutrinos also tend to be stable under the influence of the two magnetic fields. Therefore the whole system is stable.

However, because the heavier "inert antineutrinos" revolve around the lighter electrons, although the gravitational force is extremely weak relative to the Coulomb force, in the electron-neutrino system, the effects of the magnetic force and gravitational force, which are dominated by masses, will be slowly revealed. The initial circular orbit of electrons will gradually have waves, and the amplitude will gradually increase, which interferes with the stability of electrons moving around protons. The electrons will accumulate "shaking" and change the orbit, until eventually lose their balance and fly away from the protons.

In this way, the system collapses and the "inert antineutrinos" fly away naturally—speeding up to the speed of light and becoming electron neutrinos $\bar{\upsilon}_e$. Since the mass decreases, the loss of mass turns into kinetic energy. In fact, this is the so-called "neutrino redshift", which is not a neutrino oscillation at all. The three flavors of neutrinos are actually similar to the visible light, i.e. they are actually three bands (mass bands) with similar properties.

Neutrinos are actually micro-neutrons (strictly speaking, they are miniaturized hydrogen atoms). The electric charge and mass are polarized. For example, the outside of anti-neutrinos is charge positive, so it has a micro-attraction effect with electrons! Therefore, an external magnetic field can produce a non-uniform shift of its charges and create a magnetic moment, which is why we can observe that neutrinos can deflect in a magnetic field.

This is the reason why neutrons are unstable and can decay (the half decay time can be calculated per the model described so far). It is also the reason why all radioactive elements can decay. The reasons why the half-lives are different are 1) that the redundant neutrons in the nucleus are in an "unstable" state, 2) that the different synergistic resonances cause different structures and thus different nucleus stabilities.

This situation is similar to the solar system (the sun, earth and moon). The reason for the stability of this system at present: one is that the system relatively simple gravitational system; and the other is that the moon moves very slowly, whose mass is one-sixth that of the earth, and it is far away from the earth, which has little influence on the orbital stability of the earth. Its gravitational force is also uniformly dissolved by the soft mantle of the earth and the excess seawater—the formation of tides (the fluid tide of the mantle and the liquid tide of seawater) will decompose the force, so there is no accumulation and superposition effect to cause the acceleration of the earth.

Now we go back to the analysis of the formation of deuterons: when protons and neutrons （$pW^-$）collide with each other, their speed drops to 0 instantaneously (fusion), and the so-called ″excitons'' will be produced by the huge kinetic energy. The excitons will transition locally to γ photon. And the γ photons bounce off and excite protons p to n+$W^+$ (In fact, it is equivalent to dual photons generating positive and negative neutrino pairs and electron pairs). Then the $W^+$ will annihilate with the $W^-$ in the neutron and become a new γ, with the original neutron n having decayed to a proton p. Then the process repeats, with the new γ bombarding the new proton, and so on. That is to say, the γ photon acts as a catalyst to interconvert protons and neutrons.

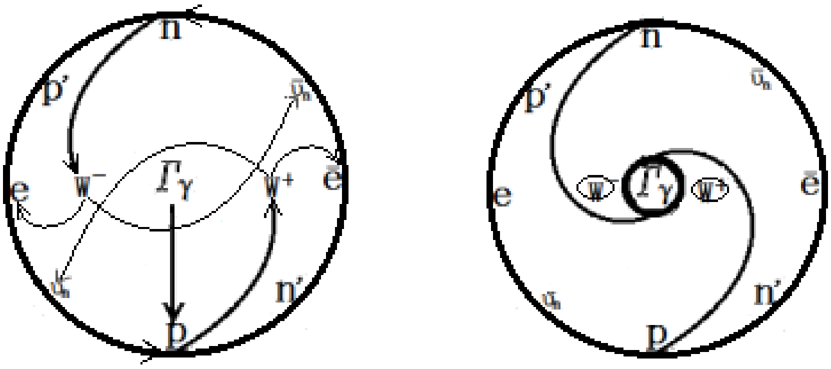
In this context, we understand what the essence of the so-called strong force (nuclear force) is: the exchange of $W^+$ and $W^-$ between neutrons and protons, under the catalysis of photons. On the other hand, the so-called weak force is actually the combined force of electrons and the inert neutrino system (the original $W^-$ bosons). Therefore, they are not fundamental forces at all.

Notably, we do not see traces of the so-called mass loss. In fact, when the γ photon excites the proton p, there is a large mass loss, which results in the radiation of the new high energy γ photon. As a matter of fact, in the large-scale collision experiments of particle physics, the so-called new particles produced are actually fragments and short-lived resonance states.

This is why scientists can't observe free proton decay at all, but can observe proton ″decay″ in the nucleus, which is actually not decay but "enlargement". Due to the principle of energy conservation and the fact that protons have less mass than neutrons, protons can not "decay" into neutrons.

Therefore, in the deuteron: 1) it is impossible to have protons and neutrons that retain the original masses, but quasi-protons and quasi-neutrons; 2) there are no fixed ″quasi-protons″ and ″quasi-neutrons″, but the two are in a state of mutual exchange! Such interconversion is produced by the fact that excitation of protons by photons generate $W^+$ which annihilate with the $W^-$ in the neutron into new photons.

Deuterons can actually be expressed as the following states:




Deuteron dynamic change diagram (Western Mode and Eastern Mode)

It is similar to the interaction between the two H atoms in the H2 molecule (covalent bond, van der Waals force). Instead of a shared electron pair, two photons and positive and negative W boson pairs are shared.

So far we know that the "quasi-protons" and "quasi-neutrons" in deuterons are actually not fixed, but are always interconverting to each other. Because the binding energy of each atom is different, the masses of the quasi-protons and the quasi-neutrons are also not fixed. The greater the binding energy, the lower the masses. The corresponding photon energy is also different. The system is in a state of "self-sufficiency" and mutual integration and transformation.

When the deuteron accepts another neutron, it becomes tritium $^{3}H$. Since the neutron has a similar structure to the H atom, the two neutrons can interact weakly (more like van der Waals forces between molecules), but are unstable. However, they will fight for gamma photons inside the deuteron. Therefore a triton is equivalent to two quasi-neutrons and one quasi-proton sharing a pair of gamma photons (moving back and forth). It is similar to the conjugate π bond in chemical systems. Actually it is a "nuclear $\pi_3^1$ bond". Also there is always a quasi-neutron that is relatively free. Therefore tritium is unstable and radioactive (half-life is 12.43 years).

If a deuteron accepts a proton, it forms $^{3}He$, which is equivalent to one quasi-neutron and two quasi-proton sharing a γ. It is also a "nuclear $\pi_3^1$ bond". However the relatively free quasi-particles are relatively stable quasi-protons. Therefore they are very stable.

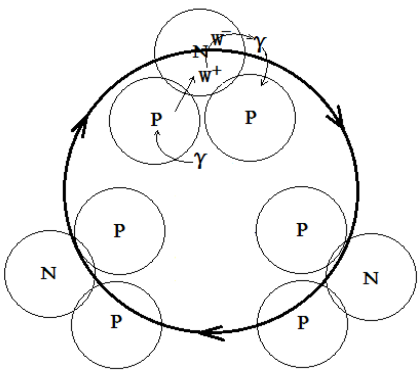
And two-deuterium binding is $^{4}He$, which is equivalent to two quasi-protons and two quasi-neutrons spaced and sharing four gamma photons in cycles. Therefore it is more stable. See figures below.

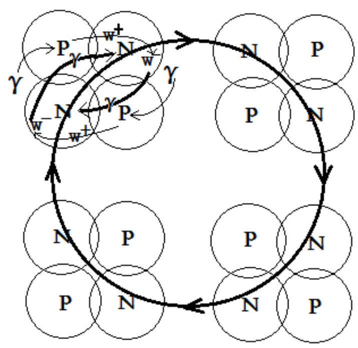
By analogy, it seems that the larger nuclei are "nucleon rings". Although their shapes may vary widely, there should be patterns to be found. The rings could spin. The quasi-neutrons and quasi-protons are spaced from each other. Two quasi-neutrons can appear next to each other. The connection is similar to the weak effect of van der Waals force between molecules, but must be greater than the tension of the nucleon ring. Also the fusion period must be longer than the neutron lifetime for the connection to be relatively stable. However there will not be two quasi-protons connected because the Coulomb's force is too large. It is the cyclic interconversions that make this kind of nucleus structures stable, just like the conjugated benzene rings.

However, just as atoms generally can only form stable rings of five or six atoms, atomic nuclei may only form stable ring structures with five or six nucleons. However, for artificially synthesized multi-neutron elements such as helium 5 and helium 6, since the force between neutrons, which is derived from the Coulomb force between protons, is much smaller than the tension of the nucleon-ring, they are actually not stable. Strictly speaking they do not exist. They are only resonance states, not basic elements. Anything with a lifetime less than that of neutrons is not an element. As for tritium, although it has only two quasi-neutrons, it can not form a ring, therefore it is unstable and can decay.

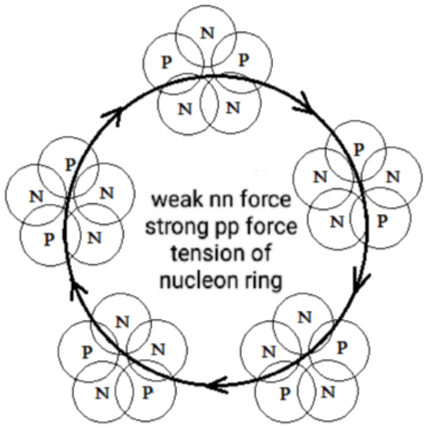
In fact, since $W^+$ and $W^-$ are structures composed of positrons/neutrinos and electrons/antineutrinos respectively, a "deuterium unit" (i.e., a pair of quasi-neutrons and quasi-proton) can be split into four interacting angles, namely, positrons, neutrinos, electrons, and antineutrinos, which can be used to combine with adjacent "deuterium units' via inter-annihilation producing dual gamma photons. Therefore complex multi-nucleon structures similar to diamond-like multi-carbon structures can be formed. We can consider them as deuteron crystals, with the four interacting angles just like the sp3 hybrid orbitals of carbon atoms. The extra neutrons can be embedded outside it as an unstable structure. Below certain quantities, it can maintain a stable structure. But beyond certain quantities, it becomes unstable. Nuclei with large nuclear numbers are actually deuterons (their masses are different in different nuclei) in the diamond-like structure.

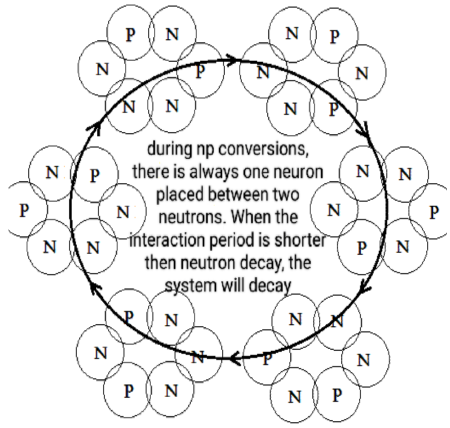
There are no "basic forces" nucleons. Rather they are in a state of lively change, self-sufficiency, mutual integration and mutual transformation. Based on this, there is a connection, which can be named "nuclear range force", but not a fundamental force.




Helium III Helium IV




Helium V Helium VI

Schematic diagram of the dynamics of nucleon rings

As can be seen from the figure, the structure of atomic nuclei (except helium 3) can be expressed as follows: x(pn)y($pn_2$)z($pn_3$), where pn is a stable structure, regardless of the value of x; $pn_2$ is a sub-stable structure, which becomes more unstable with the increase of the y value (relatively small and stable); while the z value is small, and $pn_3$ is an extremely unstable structure, which belongs to the synthetic category (actually it cannot be called a basic element, but only a transitional resonance state, which does not exist in natural elements).

In fact, with the knowledge of the neutron-related internal cause in nuclei decay, we can not call elements with a half-life shorter than that of neutrons basic elements at all.

Therefore, the natural (or synthetic with half-life greater than neutron) elemental structure is x(pn)y($pn_2$). This structure can explain the law of fission of many radioactive elements.

With the knowledge of the true structural state of the atomic nucleus, the mystery of quasars, which has puzzled the physics community for many years, might be easy to unravel. Also there could be a breakthrough in synthesizing stable heavy nuclei. This could lead to the study of the real physical and chemical properties of heavy elements.

Precious metals such as gold and platinum could be simply synthesized! Special existences in nature are enough to prove the possibility of this synthesis, such as the existence of the asteroid 2011 UW-158 containing 100 million tons of platinum and the Cancer K Star with at least 100 billion tons of gold on the surface. Such a huge amount of platinum and gold is impossible from accidental external capture.

And the success of this new synthetic method to create stable heavy elements can in turn prove the correctness of the above atomic nucleus structure theory. Eventually the evolution model of the universe and galaxies will be more perfect.

references:
1. Frontier Science, February 2017
2. European Journal of Physics, Vol. 78, 28 (2018)