SCIREA Journal of Physics
ISSN: 2706-8862
https://www.scirea.org/journal/Physics
October 23, 2019
Volume 4, Issue 6, December 2019

An interesting model of proton, neutron, nucleus, atom and molecule

Liu Taixiang[1,*]
[1]Laboratory of Physics of monism with two-state, Jinan, China
Email address:
taixiang.l@126.com (Liu Taixiang)
[*]Corresponding author

Abstract

According to the model of photon in the Theory of system relativity, the model of proton, neutron, nucleus, atom and molecule are given in turn, which explain some of the properties of these particles, and give independent conclusions to related cutting-edge research topics or problems. For example, the property of a quadrupole moment, the decay of proton, super-heavy nuclei, the Pauli exclusion principle and so on.

Keywords: the model of proton, the model of neutron, the model of nucleus, the model of atom, the model of molecule, boundary conditions of a stable nucleus, the decay of proton, super-heavy nuclei.

1. Introduction

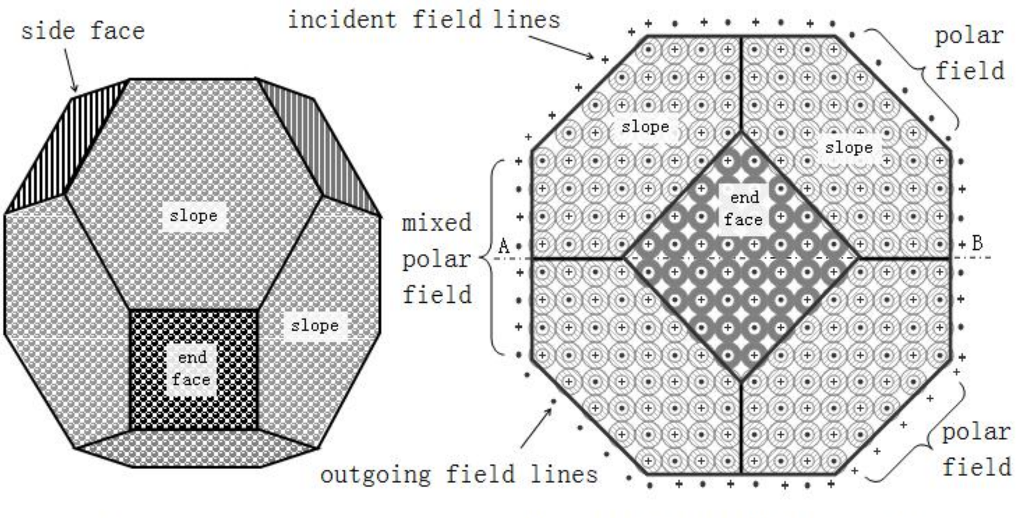
In modern physics, the proton and neutron are the basic units that constitute the nucleus. An atom consists of a positively charged nucleus and extranuclear electrons with an equal total amount of negative charge and therefore manifests as electrically neutral. Over the past century, we have not been able to successfully establish a relatively complete atomic model because of the lack of an effective model of the nucleus.As we have gradually come to understand the charge independence of the strong nuclear force, our understanding of atomic physics constructed on the basis of the concept of positive and negative charge has become questionable. A set of atomic theories based on charge independence will need to be established.

2. Tetradecahedral model of the proton

Based on the analysis of many experimental data concerning atoms and nuclei, in the Theory of System Relativity [1], it is proposed that the proton is a stable-state tetrahedral-hexahedral particle with 14 regular faces that is composed of photons [2] with various lengths. As shown in Figure 1, the surface of the proton is composed of eight equal regular hexagons and six equal squares. Specifically, two squares constitute two opposing sides of the proton, and the remaining four squares constitute four additional sides of the proton; on the front and rear halves of the proton, there are four slopes, each of regular hexagons. In comparison with the electron [1], the proton is nearly spherical.

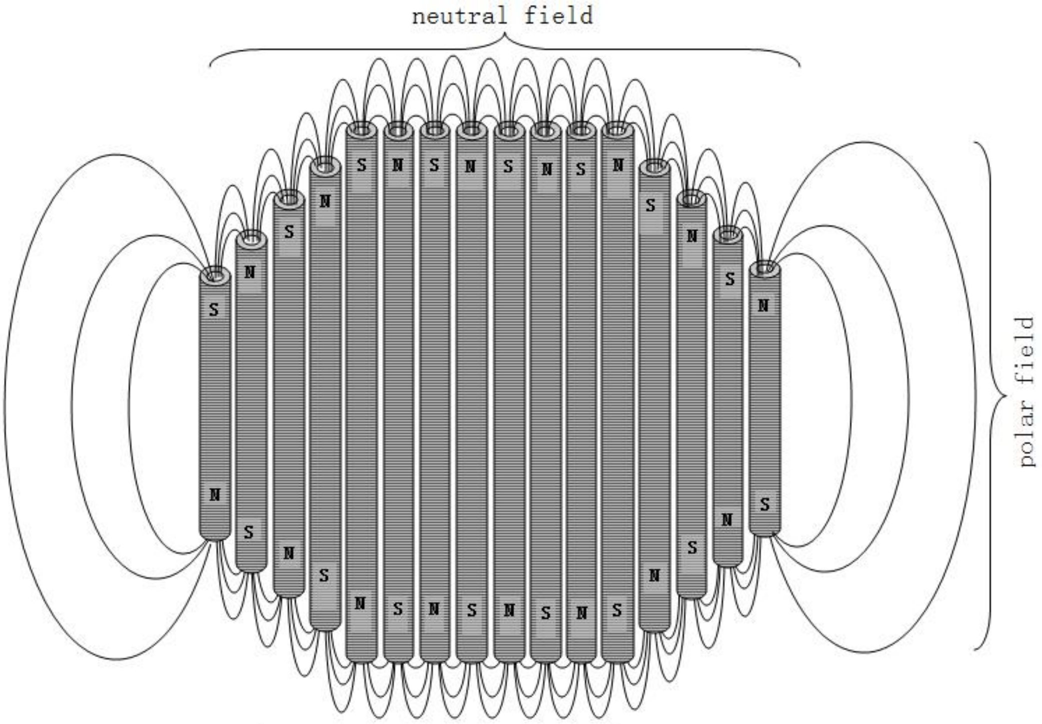
2.1. Field structure of the proton

When viewed from one end, the proton is an octagon, as shown in Figure 1b. The field-line distribution on the four side faces is an interlaced distribution of forward and backward field lines that corresponds to the poloidal interlaced distribution of photons on the side faces. This field is different from a polar field with field lines that all lie in the same direction, and it is also different from the neutral field on the end faces of the proton; it is called a **mixed polar field.**



a. 3-D diagram of the proton

b. field distribution on the front face of the proton



c. schematic illustration of the AB cross section

Figure 1 Structure and field of the proton

On the common boundary of the front and rear slopes of the proton, there is a relatively small polar field, which originates from very small photons on the boundary. In general, this polar field is located within the critical field of the proton and is not involved in the interactions of the proton with the external environment. By contrast, the size of the mixed polar field on the side faces is much larger; this field does participate in interactions with the external environment and exhibits the well-known proton properties of a positive charge and a quadrupole moment.

It is clear from the figure 1 that the neutral field occupies the vast majority of the surface of the proton. Therefore, the field of the proton is dominated by the neutral field, and the field of the proton is a composite field that consists of a neutral field and a polar field.

2.2. The mass and charge of the proton

In modern nuclear physics, it is commonly accepted that the proton carries a positive charge of $e=1.6\times10^{-19}$ C and has a rest mass of $m_p=1.67\times10^{-27}$ kg. In the Theory of System Relativity, the composite-field property of the proton determines that the proton possesses both mass and "charge." That is, the neutral field of the proton determines its mass property, and the polar field determines its charge property.

Similar to the fact that the field domain of the Sun can accommodate eight planets although the mass of the Sun is much larger than the sum of the mass of the eight planets, in the case of the hydrogen atom, although the field domain of one proton can accommodate only one electron orbiting the nucleus, this does not mean that the "charge" of the proton is necessarily equal to the "charge" of the electron. Hence, the statement that "the proton carries one unit of positive charge" is worthy of further discussion.

In fact, in the case of the hydrogen atom, the primary interaction between the proton and the extranuclear electron is not the so-called electromagnetic interaction between their polar fields. The attractive force between their neutral fields also plays an important role in the motion of the electron, and this attractive force is not negligible. Therefore, it is not correct to believe that "the attraction between the proton and the electron in the hydrogen atom can be neglected."

3. Composite-particle model of the neutron

In modern physics, the neutron is believed to be a neutral particle (without charge) with a spin of 1/2. In nuclear physics, the neutron and the proton are typically considered as two different charge states of the same particle, and they are differentiated by their isospin quantum numbers. Scattering experiments with high-energy electrons, μ particles, or neutrinos incident on neutrons have indicated that there is a certain distribution of charge and magnetic moment inside the neutron, which implies that the neutron is not a point particle and that it possesses a certain internal structure.

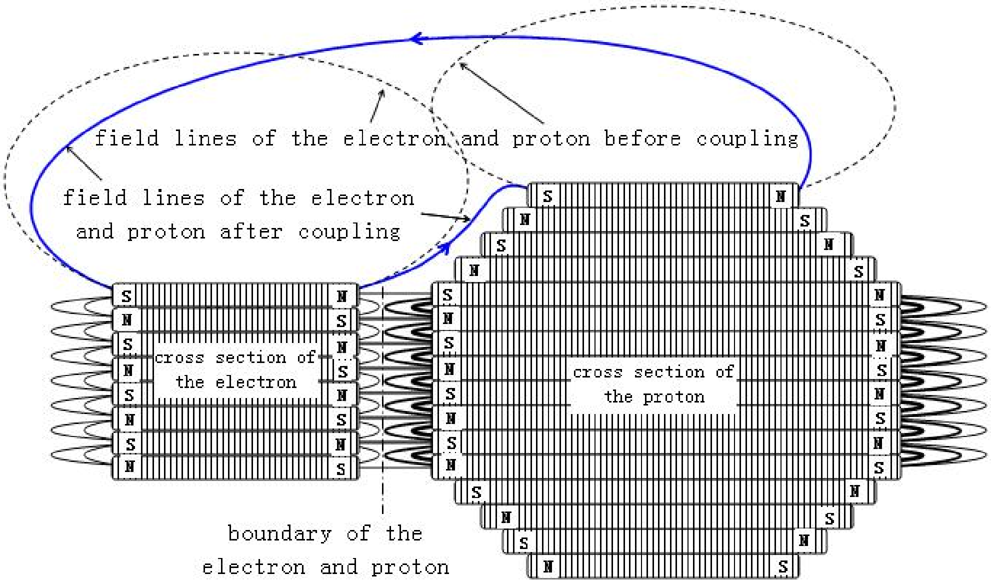
3.1. Neutron model

The neutron model constructed in the Theory of System Relativity is illustrated in Figure 2a. The composite particle formed through the mutual coupling between the neutral field on one end of the electron and the neutral field on one end of the proton is called the neutron.

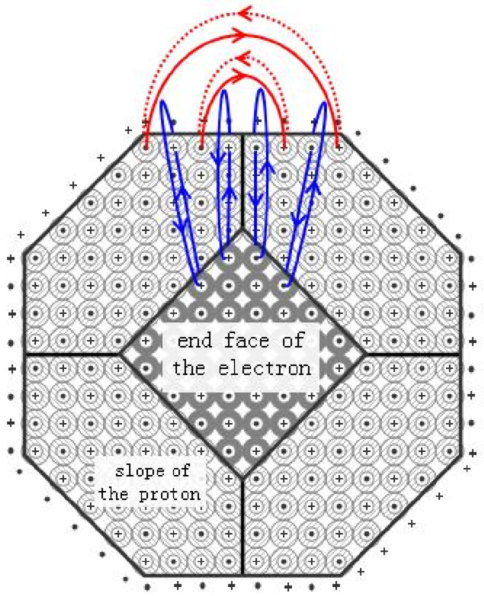
As shown in Figure 2a (the neutral field on the slope of the proton is not shown; see Figure 1), on the one hand, the neutral field lines on the end faces of the electron and the proton are coupled to each other; this is the attractive force between neutral fields. On the other hand, the polar field lines between the electron and the proton are also mutually coupled; this is the so-called electromagnetic interaction between polar fields.

According to Figure 2b, the polar field lines on the side faces on the front half of the electron and the polar field lines of the photons that are oriented in the same polar direction on the side faces on the front half of the proton are coupled to each other. As shown in Figure 2a, these coupled field lines further contract and converge into the neutron. Hence, those polar field lines that are not initially coupled to the electron, in both the forward and backward directions on the two symmetric halves of the proton, shift toward the central line and eventually meet, resulting in coupling. The red solid lines in Figure 2b represent the field lines coupled at the front end, and the red dashed lines represent the field lines coupled at the rear end.

As mentioned above, compared to the proton, the polar vortex flux of the neutron converges to a smaller domain, resulting in a lower polar vortex flux; additionally, the neutron, which is constructed through the coupling of an electron and a proton, has a larger radius than the proton, and its surface polar field strength is correspondingly weaker than that of the proton. This is the reason for our observation in the macroscopic environment that "the neutron has no charge."



a. Cross-sectional schematic diagram of the coupling of the polar field lines of the electron and proton



b. Schematic diagram of the distribution of the coupling of the polar field lines between the electron and proton

Figure 2 Schematic diagrams illustrating the principle of the coupling between the polar field lines of the electron and proton inside the neutron

According to the fusiform model of the nucleus (see section 4.1), an electron and a proton attached to the surface of the nucleus combine to form a neutron, which is why people view the neutron as a nucleon. Of course, as a nucleon, the neutron can be located only on the surface of the nucleus.

3.2. The mass of the neutron

In nuclear physics, the rest mass of the neutron is $m_n=1.675\times10^{-27}$ kg. By comparing m_n, m_p, and m_e, it is not difficult to find that $m_n>m_p+m_e$. In other words, when a proton and an electron combine to become a neutron, there is an increment in their total mass. On the basis of this observation, N. Bohr suggested that the law of energy conservation is violated in beta decay.

In the spring of 1931, an International Nuclear Physics Conference was held in Rome, and W. Pauli proposed to the assemblage that the law of energy conservation should still hold for beta decay. The cause of the energy loss is that the neutron, as a neutral particle with a large mass, becomes a proton, an electron, and a neutral particle with a small mass during beta decay. This small-mass particle then carries away the additional energy. The "thief" predicted by W. Pauli to steal the additional energy of the process was the neutrino. The Theory of System Relativity proposes a different interpretation.

In fact, the mass of the neutron, m_n, is proportional to its neutral vortex flux Φ_m. According to the hair-growing principle of nuclei (see section 4.2) and the neutron model illustrated in Figure 2, the radius of the neutron is larger than the radius of the proton. Therefore, the energy of a photon attached to the surface of the neutron is higher than that of a photon attached to the surface of the proton, and the energies of these photons are primarily reflected in the form of the neutral field, namely, in the form of mass. Therefore, when a proton and an electron combine to become a neutron, there must be a gain in mass. Otherwise, there will be a mass deficit. This change in mass is not related to the neutrino.

In summary, in the context of the proton and neutron models in the Theory of System Relativity, the concept of isospin and the quark model are both worthy of further discussion.

4. nucleus

4.1. Model of the nucleus

4.1.1. Cohesion of two protons

In physics, we typically refer to both protons and neutrons as nucleons, namely, the nucleus consists of protons and neutrons. According to the model of the neutron presented in section 3, a neutron instead consists of protons and electrons. Therefore, it is more appropriate to consider the nucleus to consist of protons and electrons.

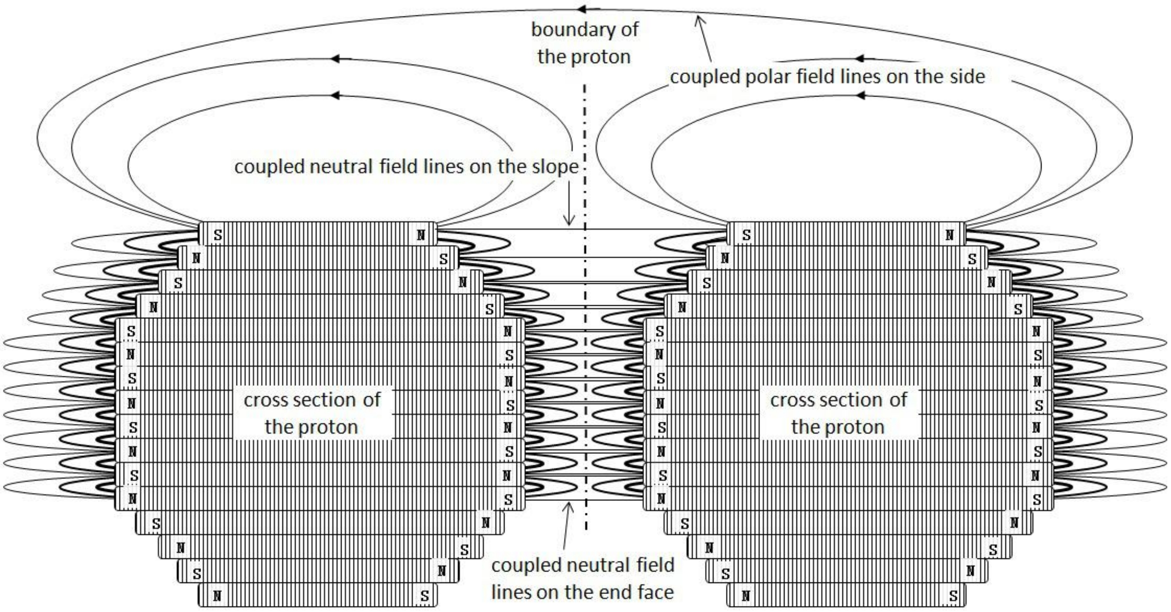


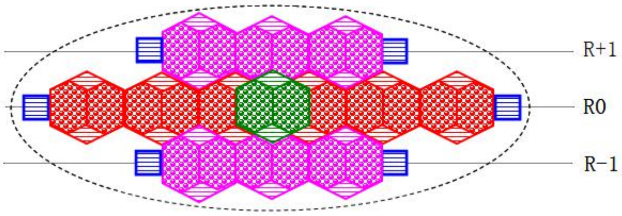
Figure 3 Principle of the coupling of field lines between protons

In the nucleus, protons are condensed together through the coupling of field lines. The mechanism of coupling between protons and electrons is defined in the discussion of the model of the neutron. According to the model of the proton presented in section 2, the neutral field on the end face of the proton is stronger than those on the slopes and side faces; therefore, two protons condense together by means of their end faces.

As shown in Figure 3, for two condensed protons, their interior photons correspond to each other, and their polarities are opposite. The field lines of the neutral fields on their end faces, the neutral fields on their slopes, and the polar fields on their side faces are all mutually coupled. All the coupling forces of these coupled fields jointly constitute the so-called strong nuclear force in physics.

4.1.2. Fusiform model of the nucleus

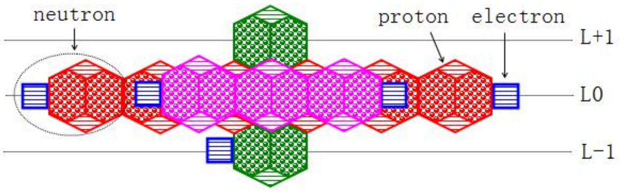
Let us consider the nitrogen nucleus as an example. As shown in Figure 4, the nitrogen nucleus has three structural symmetries: up and down, left and right, and front and rear. The longest string of protons and electrons at the center of the nucleus is called the mid-axis of the nucleus, which is denoted by R0/L0. The face corresponding to L0 is also called the **main face** of the nucleus. As shown in Figure 4a, the axes corresponding to the two bunches of protons and electrons on the upper and lower sides, respectively, are denoted by R+1 and R-1. Similarly, the axes corresponding to the two bunches of protons and electrons on the front and rear sides, respectively, are denoted by L+1 and L-1 (see Figure 4b). For the ^{14}N and ^{15}N nuclei, the numbers of protons and electrons on each axis are shown in Figures 4c and 4d. For two adjacent protons on different axes, their axis positions differ by half a proton.



a. Plane view of the ^{14}N nucleus

^{14}N	R+1	R0	R-1
L+1		1p	
L0	3p2e	6p2e	3p2e
L-1		1p1e	

c. Nucleon arrangement of ^{14}N



b. Side view of the ^{14}N nucleus

^{15}N	R+1	R0	R-1
L+1		2p1e	
L0	3p2e	6p2e	3p2e
L-1		1p1e	

d. Nucleon arrangement of ^{15}N

Figure 4 Schematic illustrations of the nuclear structure of ^{14}N

According to the model of the nitrogen nucleus, the nucleus is a fusiform body condensed from protons and electrons. In the nucleus, protons are regularly arranged in the same direction, and protons on adjacent axes lie closely against each other without any gap. The cross-sectional view of the nucleus exhibits an alveolar structure. The matter density of the nucleus is extremely high. For all adjacent protons, their associated photons are opposite in polarity and tightly coupled (see Figure 3), thereby constituting the strong-force property of the nuclear force. Electrons are attached to the protons on the surface of the nucleus. Each electron and the proton to which it is attached form a particle known as a neutron. Therefore, the experimentally observed neutrons are all distributed on the surface of the nucleus.

As shown in the nuclear structure model above, the nuclear force is constituted jointly by the coupling forces between multiple neutral fields and polar fields of nuclei, and the coupling forces between neutral fields play the dominant role. Therefore, the nuclear force and the attractive force are of the same nature. The short-range property of the nuclear force is determined by the attenuation step size (namely, the radius of the proton) of the field strength on the Fermi level of the proton.

4.1.3. Structural models of some nuclei

According to the principle of the fusiform model of the nucleus, by referring to the elemental abundances of chemical elemental theory and the periodic law, we can establish the models of nuclear structure and clarify the nucleon arrangements in the nucleus for the elements in the first two rows of the periodic table of the elements, as shown in Figure 5 and the table 1.

table 1

axis / element	L+1		L0					L-1	total	elemental abundance
	R+1	R0	R+2	R+1	R0	R-1	R-2	R0		
^{1}H					1p				1p	99.985%
^{2}H					2p1e				2p1e	0.015%
^{3}He					3p1e				3p1e	0.00014%
^{4}He					4p2e				4p2e	99.99986%
^{6}Li				1p1e	5p2e				6p3e	7.5%
^{7}Li				2p2e	5p2e				7p4e	92.5%
^{9}Be				2p2e	5p1e	2p2e			9p5e	100%
^{10}B		1p1e		2p1e	5p2e	2p1e			10p5e	19.6%
^{11}B		1p1e		2p1e	5p2e	2p1e		1p1e	11p6e	80.1%
^{12}C				3p2e	6p2e	3p2e			12p6e	98.89%
^{13}C		1p1e		3p2e	6p2e	3p2e			13p7e	1.11%
^{14}N		1p		3p2e	6p2e	3p2e		1p1e	14p7e	99.634%
^{15}N		2p1e		3p2e	6p2e	3p2e		1p1e	15p8e	0.366%
^{16}O		3p2e		3p2e	6p2e	3p2e		1p	16p8e	99.762%
^{17}O		3p2e		3p2e	6p2e	3p2e		2p1e	17p9e	0.038%
^{18}O		3p2e		3p2e	6p2e	3p2e		3p2e	18p10e	0.200%
^{19}F		2p2e		4p2e	7p2e	4p2e		2p2e	19p10e	100%
^{20}Ne	1p	2p2e		4p2e	7p2e	4p2e		2p2e	20p10e	90.48%
^{21}Ne	1p	2p2e	1p1e	4p2e	7p2e	4p2e		2p2e	21p11e	0.27%
^{22}Ne	1p	2p2e	1p1e	4p2e	7p2e	4p2e	1p1e	2p2e	22p12e	9.25%

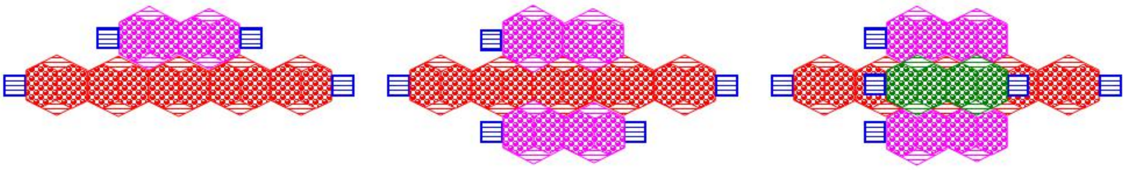
According to the figure 5 and table 1, for elements with an abundance of 100%, the nuclear structure has symmetrical properties in three directions; for elements with very low abundance, the symmetry of their nuclear structures is also very poor. Between different isotopes of the same element, the isotope with the superior symmetry of nuclear structure tends to have the higher abundance. Presumably, a so-called “magic nucleus” is a nucleus with relatively good symmetry of nuclear structure.

Therefore, we can draw the following conclusion: the greater the number of protons on the central axis or main surface of the nucleus is and the farther the protons are from the central axis or main surface, the fewer protons there will be on a particular axis or surface. Only when the number of protons on the central axis is no less than 4 will there be protons on the two side axes. Moreover, the difference between the number of protons on the central axis and the number of protons on the side axes is generally not less than 3. and so on.

It should be noted that the aforementioned model of nuclear structure is in a preliminary stage. Many possibilities are yet to be evaluated to determine which are true, especially regarding the arrangement of protons and electrons on axes other than the central axis. Only through experimental observation can we determine the only true arrangement from these many possibilities or confirm the further division of isotopes.

In the context of this model, it is worth considering the concept of the "atomic mass unit."

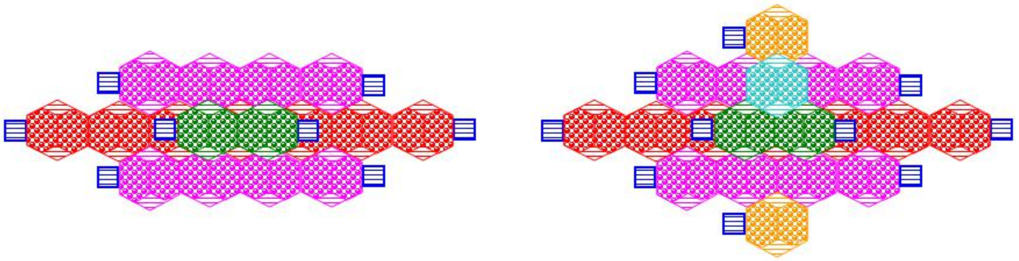
Through international consensus in the physics community in 1960, 1/12 of the rest mass of a neutral ^{12}C atom in the ground state was defined as the atomic mass unit. According to the model of the nucleus presented here, the nucleus has a complicated field structure consisting of a neutral field and a polar field; the "atomic mass unit" is merely a very crude approximation with which to describe the nucleus.



a. Nucleon arrangement for the ^{7}Li nucleus

b. Nucleon arrangement for the ^{9}Be nucleus

c. Nucleon arrangement for the ^{11}B nucleus



d. Nucleon arrangement for the ^{19}F nucleus (plane view or side view)

e. Nucleon arrangement for the ^{22}Ne nucleus (plane view)

Figure 5 Schematic illustrations of the nuclear structures of selected elements

4.2. Nuclear hair-growing principle and atomic spectra

4.2.1. Nuclear hair-growing principle

In the external field of a nucleus, in addition to the vortex tube (field lines) with the nucleus as the vortex core, there are many **free vortices** distributed between the field lines. These sourceless free vortices are generated by the nuclear field lines, and they combine with the field lines of the nucleus to constitute the external field of the nucleus.

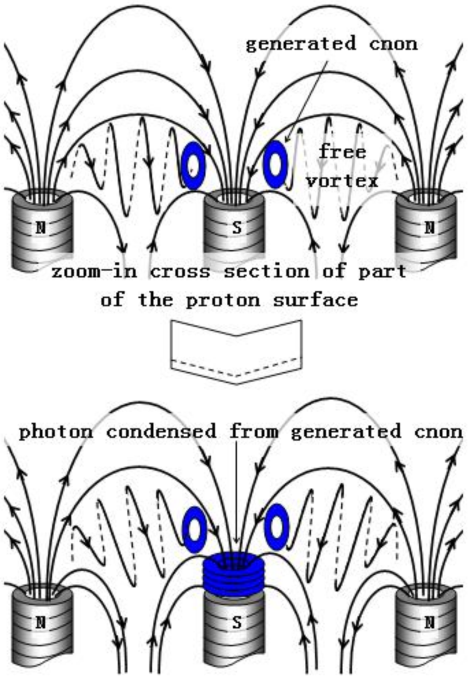
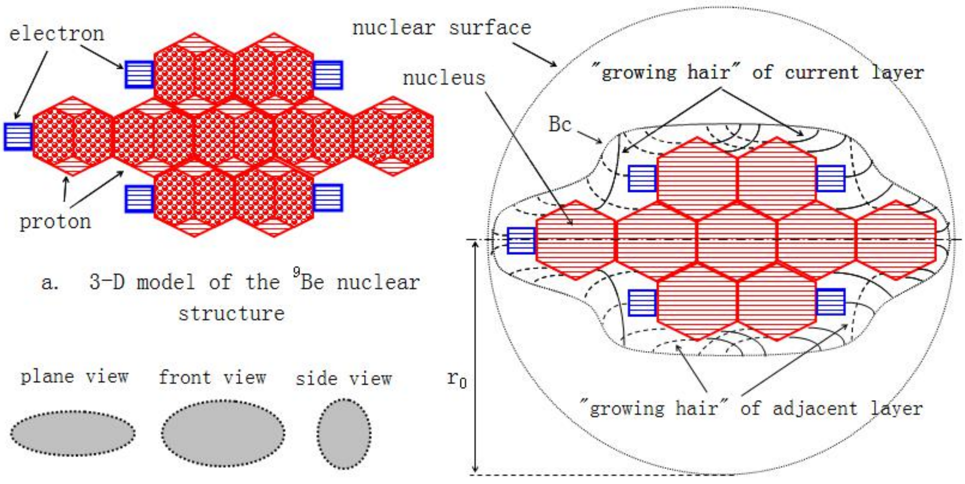


Figure 6 Schematic illustration of the "hair-growing" principle of the nucleus

According to the model of the nucleus presented in section 4.1, the nucleus is primarily composed of protons, which are agglomerates of photons. The field lines of the nucleus exit from the N poles of photons in surface protons and enter at their S poles. As shown in Figure 6, the free vortices interjected between the field lines at the S poles of photons change covariantly with the field lines. If the field lines are closer to the S poles, the vortex motion is stronger, and the corresponding vortex intensity at the center of the free vortex is larger. With the continuous enhancement of the free vortex intensity, shuons at the center of the vortex mutate into cnons [1], which become attached to the surface of the nucleus. Multiple cnons become superposed to form a photon, which is called a **rest photon.**



a. 3-D model of the ^{9}Be nuclear structure

c. Morphology of the nucleus under a microscope

b. Schematic illustration of the process of "growing hair" on the cross section of ^{9}Be

Figure 7 Schematic illustration of a nucleus "growing hair" and its morphology

As shown in Figure 7b, the polarities of the outer ends of such rest photons are the same, and they repel each other. They diverge outward from the surface of the nucleus and wave with the vibration of the nucleus and the motion of extranuclear electrons, just like hairs growing from the nucleus. Therefore, the process in which the surface of the nucleus produces photons is referred to as the **nucleus growing hair**.

As the rest photon grows, the field strength on its outer end continuously decreases. When the field strength decreases to B_c, the intensity of the vortex motion at the center of the free vortices is no longer sufficient to generate single-shuon vortex rings. As a result, shuons no longer mutate into cnons, and the stationary photon ceases to grow.

The nucleus in the stable state is a furry ellipsoid with its entire surface covered with growing "hair," as shown in Figure 7c. Under a microscope, with the constant rotation of the nucleus, namely, variation in the angle of observation, we can see that the shape of the nucleus constantly changes like a suspended droplet. As described by F. Wilczek, the nucleus is like a soft gel.

4.2.2 Vacuum fluctuation and vacuum condensation

According to quantum field theory, quantum fields can interact with each other in free space. On the one hand, various virtual particles are therefore created, destroyed, and transformed in free space (vacuum) in the phenomenon known as "vacuum fluctuation"; on the other hand, there is coherent condensation of certain bound states of particles and collective excited states in the phenomenon known as "vacuum condensation."

According to the nuclear hair-growing principle, the surface of the nucleus can continuously generate cnons. Once cnons are produced, they immediately condense to the surface of the nucleus and "disappear." If we consider this process to correspond to vacuum fluctuation, then instead of virtual particles, vacuum fluctuation generates cnons; the so-called disappearance of these particles simply means that free-state cnons are converted into bound states rather than truly disappearing, and the so-called transformation of these particles is simply the unidirectional conservation of shuons and cnons.

As mentioned above, once cnons are generated on the surface of a nucleus, they will become attached to the surface of the nucleus and become part of a photon, namely, the cnons are converted from the free state to the bound state. In other words, many free-state (excited-state) cnons condense to form a stationary photon through coherence (the N pole and S pole of adjacent cnons correspond to each other). If we consider this process to be "vacuum condensation," then vacuum condensation describes the process of cnons condensing into photons, which has no direct relation to free space (vacuum). Of course, cnons are a special form of shuon (which is the basic unit that constitutes free space).

4.2.3. Characteristic atomic spectra

In modern physics, it is believed that an atomic spectrum is a spectrum of light with a series of wavelengths that is emitted or absorbed upon the electrons in the atom undergoing some change in energy. The spectrum of each type of atom is different and is therefore referred to as the characteristic spectrum of that atom. Atomic spectra acquired through energy dispersion using spectrometers with relatively high resolution have also revealed that the spectral lines possess fine structure and hyperfine structure. All these characteristics of atomic spectra reflect the regularity of electron movement inside the atom.

In quantum mechanics, the atom can be in different stationary states depending on the different motion states inside the atom. Every state has a certain energy. The state with the lowest energy is called the ground state, and a state with energy higher than the ground state is called an excited state. These states constitute the energy levels of the atom. A high-energy excited state can jump to lower energy states while emitting photons. Conversely, relatively low-energy states can absorb photons to jump to relatively high-energy excited states. The frequencies of the emitted or absorbed photons constitute the emission spectrum or absorption spectrum of the atom.

According to the hair-growing principle of nuclei, a given type of nucleus can only generate photons of its specific "standard" series, which means that it has its own spectral structure (the highest possible frequency of a photon generated by the nucleus is called the **frequency bandwidth** of the nucleus). Different nuclei can generate different "standard" series of photons, leading to the formation of the characteristic spectral lines of the atom; atoms with greater atomic weights can generate photons with higher energy. Therefore, a heavy metal is more radioactive than a light metal, namely, a heavy metal has a larger frequency bandwidth than a light metal.

Therefore, every nucleus is a "photon factory" that constantly converts shuons into cnons to assemble photons in certain "standard" series. Different nuclei have different field structures, which determine that only certain photons can easily move around the nuclei, as detailed section 5.3.

4.3. Examination of nuclear radioactivity

4.3.1 Mechanism for the generation of radioactivity (decay)

As we know, radioactivity can be divided into natural radioactivity and artificial radioactivity. Most radioactive elements belong to three main radioactive series composed of heavy elements, namely, the thorium series, uranium series, and actinium series.

The natural radioactive elements typically emerge from underground to the surface (crust) through volcanic eruption or crust movement. According to the Theory of System Relativity, the natural radioactive elements are generated in the underground environment (otherwise, according to the age of the Earth, the Earth must have originated from a strongly radioactive celestial body, which apparently is not true). In the high-temperature and high-pressure underground environment, these radioactive elements are in the liquid state. Because of the interactions between a large number of free photons and nuclei, the interaction between atoms is relatively weak, and therefore, the atoms are in a stable state. In other words, the radioactive elements are not actually radioactive at this stage.

When these elements reach the crust, the change in environment causes the radioactive elements to enter the solid state. The number of free photons involved in interactions decreases, and the interactions between adjacent atoms and between extranuclear electrons and nuclei significantly increase. Because these interactions are periodic and consistent with the intrinsic vibration frequency of the nucleus, nuclear resonance occurs. This state is called the "**resonant state**" of the nucleus.

Just as the vibration of maracas will cause the shedding of surface sand particles, a nucleus in the resonant state vibrates so violently that the surface particles vibrate with greater magnitude. Therefore, the binding force between the surface particles of the nucleus and the nucleus itself weakens significantly; in other words, the bonding energy of the surface particles significantly decreases. Upon any disturbance from the adjacent atoms, some surface particles can easily fall off and be radiated, thus constituting the radioactivity of the nucleus.

Different radioactive elements have different nuclear structures and resonance strengths. Therefore, their periods of decay and the types of particles they radiate are also different. According to the fusiform model of the nucleus, the surface layer of the nucleus contains photons, electrons, protons, and neutrons. These particles can be easily emitted. The outermost side axis of some nuclei is of the helium-nucleus structure (two ends of four photons in series attached to two electrons), and these nuclear species are prone to α decay; because the surface of the nucleus is covered by "hair," i.e., photons, nucleus α or β decay is typically accompanied by the emission of photons with multiple frequencies.

4.3.2. Boundary condition for the existence of objects and particles

According to the discussion presented above, the natural radioactive elements are not inherently unstable; the stability of the nucleus depends on its external environment. Here, the external environment refers to the temperature and pressure conditions between nuclei, which directly affect the interactions between nuclei and the stability of the nuclei.

According to the Theory of System Relativity, the stability of an object or particle depends on whether its critical field is destroyed. In other words, if the critical field of an object or particle is intact, it is in a stable state; by contrast, if the critical field of an object or particle is destroyed, it is in an unstable state.

As shown in Figure 8, let the space energy densities (which, in short, is called the space densities, and corresponds to the field strength) of the surface of a cnon, an electron, a proton, a nucleus, and a normal object be ρ_{cn0}, ρ_{e0}, ρ_{p0}, ρ_{nu0}, and ρ_{ob0}, respectively, and let the external space density be ρ. Then, their stable states are defined as follows:

$$\rho_{cn0}>\rho,\ \rho_{e0}>\rho,\ \rho_{p0}>\rho,\ \rho_{nu0}>\rho \text{ and } \rho_{ob0}>\rho \qquad (1)$$

In both physics and the Theory of System Relativity, environmental conditions are characterized in terms of temperature and pressure (intensity of pressure); however, the definitions of temperature and pressure are different. In the Theory of System Relativity, pressure essentially means the internal stress of the shuon fluid, which corresponds to the space density and is not related to atmospheric pressure or the pressure of macroscopic interaction; temperature means the photon energy density in the domain and is related to pressure through the average boundary space density of the photons. Therefore, with regard to the condition for the stable state of an object or particle, both temperature and pressure affect this stability by means of destroying the critical field of the object or particle.

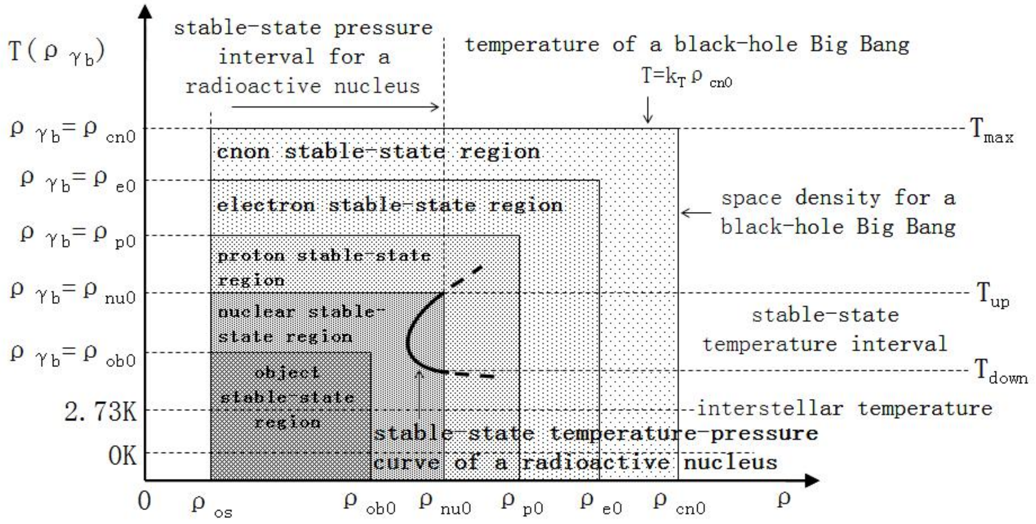


Figure 8 Relationships between the stable-state properties of particles and the environment

In the entire Universe, the critical point for the Big Bang of a black hole is the highest existence boundary for objects, and the corresponding temperature and pressure are ρ_{cn0} and T_{max}, respectively. The opposite extreme is the boundary of the field domains (namely, interplanetary space) of adjacent black holes, which is the minimum existence boundary for objects in the Universe, and the corresponding temperature and pressure are ρ_{os} and T_{min}, respectively (namely, the interplanetary temperature of 2.73 K). Therefore, in our Universe, the existence boundaries (ρ and T) for objects (including particles) are as follows:

$$\rho_{os} \leqslant \rho < \rho_{cn0} \text{ and } T_{min} < T < T_{max} \qquad (2)$$

The equation above also defines the normal boundary conditions of the Universe.

4.3.3. Boundary conditions of a stable nucleus

Using the nuclei of radioactive elements as an example, when these elements are inside the Earth, the external temperature and pressure conditions (ρ and T) of the nuclei are in the range of

$$\rho < \rho_{nuo} \text{ and } T_{down} < T < T_{up}, \qquad (3)$$

and these nuclei are in the stable state within this range. When these elements emerge from the interior region of the Earth to the Earth’s surface because of crustal movement, on the one hand, they will enter the solid state as the temperature decreases; on the other hand, because the photon density between the nuclei will decrease (temperature T in excess of the stable-state boundary), the interaction between adjacent atoms (nuclei) will increase and their spacing will decrease, causing the space density on the boundary ρ to increase and exceed the stable-state boundary. At this time, the following relations hold:

$$\rho>\rho_{nu0} \text{ and } T<T_{down} \tag{4}$$

As shown in Figure 8, a nucleus on the lower dashed-line portion of the temperature-pressure curve for a radioactive nucleus is in the unstable state because its critical field has been destroyed. Moreover, as the nucleus moves farther from the stable-state boundary, it becomes more unstable, namely, its radioactivity is stronger.

Conversely, as the radioactive elements approach the center of the Earth from the stable-state region, the photon density increases, and the space density outside the nuclei changes from the boundary space density between nuclei to the boundary space density between photons. When the boundary space density between the photons is higher than the surface space density of the nucleus, the critical field of the nucleus is destroyed, placing the nucleus is in an unstable state. Then, the following relations hold:

$$\rho>\rho_{nu0} \text{ and } T>T_{up} \tag{5}$$

As shown in Figure 8, let us discuss the upper dashed-line portion of the temperature-pressure curve for a radioactive nucleus. In fact, the point corresponding to ρ_{nu0} and T_{up} in the figure represents the limiting conditions for the generation of a nucleus. In other words, the upper dashed-line portion of the curve does not satisfy the conditions for the generation of a nucleus, and therefore, no nucleus can exist in this region. Once a nucleus enters this region, it will decay.

4.4. Will the proton decay?

Grand Unified Theory SU(5) predicts that the proton will decay, but several decades of experimental efforts have been unable to detect the decay of the proton. According to the discussion presented above, the stable-state boundary for the proton is $\rho < \rho_{p0}$. Our experimental conditions of detection are located within the stable-state boundary of the proton; therefore, we cannot detect the decay of the proton.

As shown in Figure 8, if we can construct an experiment in conditions such that the space density ρ is higher than the space density ρ_{p0} of the proton, namely, $\rho>\rho_{p0}$, we will very easily be able to observe the decay of the proton. For example, the collision experiments between two protons can construct the conditions of the decay of the proton.

4.5. Do stable super-heavy nuclei exist?

Since 1965, nuclear theory has predicted that beyond the end of the known peninsula of nuclear stability, there could be a stable island corresponding to a series of relatively stable super-heavy nuclei. The first nucleus at the center of this island should be a doubly magic nucleus with a neutron number and a proton number that both fill a closed shell ($Z=114$, $N=184$), and this nucleus should be very stable. Nuclear theory also predicts that there may be some other, heavier, super-heavy stable zones. In addition, this theory also predicts the properties of such super-heavy nuclei.

Based on the fact that heavy nuclei can decay into relatively light nuclei, it is easy to infer that natural heavy nuclei should be the results of the decay of some even heavier nuclei. Therefore, there should be super-heavy nuclei inside the Earth. However, because the stable temperature and pressure interval of these super-heavy nuclei is very small, we cannot observe them on the surface. As for the synthesis of super-heavy nuclei, because it is difficult for us to construct a temperature and pressure environment that is suitable for the generation and preservation of super-heavy nuclei, these efforts have encountered difficulties in achieving the anticipated results thus far.

However, we do not claim that it is impossible for humankind to perceive the existence of super-heavy nuclei in nature. According to the Theory of System Relativity, there are giant nuclei in the Universe that are much larger than these so-called super-heavy nuclei (the inner cores of neutron stars) as well as hypernuclei (namely, black holes). Moreover, some high-energy cosmic rays that we observe are emitted by these super-heavy nuclei.

5. Model of the atom

5.1. Field structure of the nucleus and orbital motion of extranuclear electrons

Here, we use boron-11 as an example for the discussion (neglecting the neutral field).The central longitudinal sectional view of Figure 5c is shown in Figure 9. According to this figure, the polar fields of the ^{11}B nucleus are distributed in four quadrants, and the polar fields in adjacent quadrants are perpendicular to each other. The polar field in each quadrant is composed of the (mixing) polar fields on the two side faces of the protons on the surface of the nucleus, and they have the same direction. The polar fields in the four directions are called the quadrupole moment of the nucleus in nuclear physics.

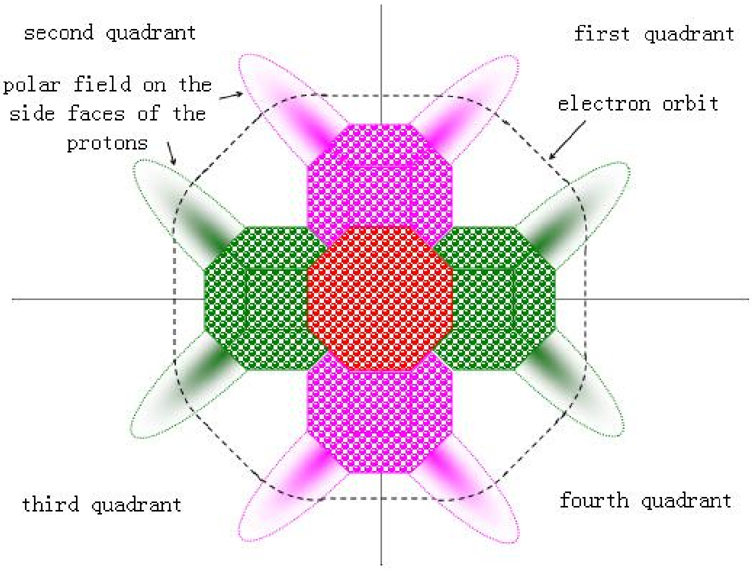


Figure 9 Field structure of the ^{11}B nucleus and extranuclear electron orbits

When an extranuclear electron enters into the polar field of the nucleus, the direction of motion of the electron will change because of the action of polar-coupled gravity. If the gravitational force of the neutral field of the nucleus is neglected, the orbit of an electron moving around the nucleus is a regular octagon, and every polar field produces a 45° (on average) deflection of the electron.

All nuclei have quadrupolar properties. The difference among them lies in the different number of polar fields for each pole. The minimum is 1, as in the hydrogen nucleus and the helium nucleus. For a larger nucleus, the number of polar fields will be larger for every pole. However, every pole produces a 90° deflection of an extranuclear electron. If the number of polar fields on every pole is large, the shape of the electron orbit approaches that of a circle.

5.2. The axially symmetric structure of the nucleus and the distribution of extranuclear electrons

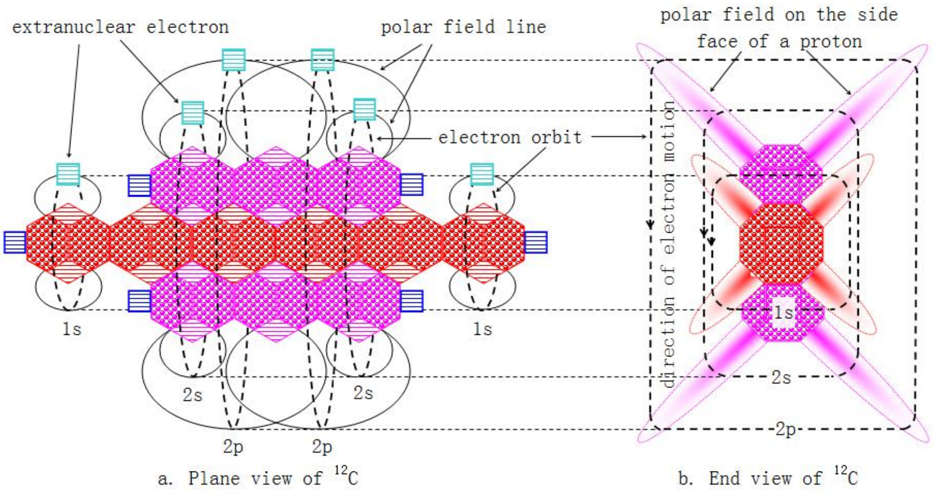


Figure 10 Schematic illustration of an extranuclear electron orbit distribution

Let us consider ^{12}C as an example, as shown in Figure 10. The orbits of the extranuclear electrons are symmetrically distributed on the right and left sides of the central axis of the nucleus, which is why the number of electrons in the electron-shell model is a multiple of 2; from outside to inside, the atom possesses 1s, 2s, and 2p orbits, and the radii of these orbits sequentially increase.

When we observe the directions of motion of the two electrons in the 1s orbit from the two ends, we will see that the directions of motion of the two electrons are opposite. That is, one moves clockwise, and the other moves counterclockwise. If we observe from one end, all extranuclear electrons in the same orbit move in the same direction. The direction of self-revolution of the electrons is consistent with the direction of orbital movement. Therefore, the directions of self-revolution of the two electrons in the 1s orbit that are actually observed are opposite. This is the nature of the Pauli exclusion principle.

5.3. Energy-level transitions of an electron

Inside an object, because of the interaction between nuclei, extranuclear electrons, and surrounding particles, the photon "hairs" of the nuclei can easily become disconnected to become free-state photons, which are the moving photons that we generally observe. A photon thus falling away from a nucleus, which usually orbits the nucleus like an extranuclear electron, is called a **bound-state photon.**

Usually, a bound-state photon has a much smaller vortex flux than an electron. A bound-state photon moves around the nucleus with a large eccentricity and relatively high velocity. Therefore, the bound-state photon actually shifts among multiple electron orbits. The photon frequently passes through the coupling domain between the electrons and the nucleus, causing disturbances in the coupling vorticity between the electrons and the nucleus and therefore resulting in constant energy-level translations of the orbital electrons.

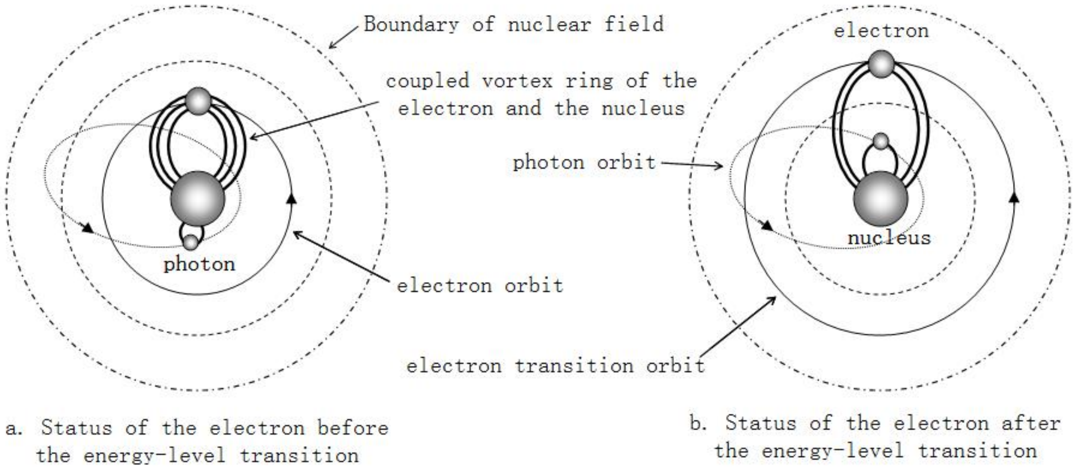


Figure 11 Schematic illustration of the principle of a jump in the energy level of an electron

The influence of a photon in the bound state on the motion of an orbiting electron is illustrated in Figure 11. When the photon enters the coupling domain between the electron and the nucleus, part of the vortex flux of the nucleus in this direction becomes coupled to the photon, causing a reduction in the coupled vortex flux between the electron and the nucleus. When the attractive coupling force of the nucleus on the electron decreases, the electron will move away from the nucleus, causing the electron to transition from a relatively low energy level to a relatively high energy level; when the photon leaves the coupling domain of the electron and the nucleus, the coupled vortex flux between the electron and the nucleus increases, and the electron once again draws nearer to the nucleus as the attractive coupling force from the nucleus increases, causing the electron to transition from a relatively high energy level to a relatively low energy level.

After the unbound photon enters the coupling domain of the electron and the nucleus, it will also cause a jump in the energy level of the electron. Because the time for which the photon remains within the coupling domain of the electron and the nucleus is very short, the corresponding energy-level jump of the electron is extremely short. Of course, if the vortex flux of the photon is higher, the magnitude of the energy-level jump of the electron is larger.

Therefore, the idea that an electron emits or absorbs a photon upon an energy-level transition is questionable. According to the data regarding the splitting of atomic spectral lines, we can infer the orbital information and energy distribution of the bound-state photon.

6. Molecular model and crystal model

6.1. Model of a water molecule

In a water molecule, as shown in Figure 12, two H nuclei are attached to two slopes on one end of an O nucleus to form a geometric structure with a 120° angle. An ^{16}O nucleus is depicted in the figure 12.

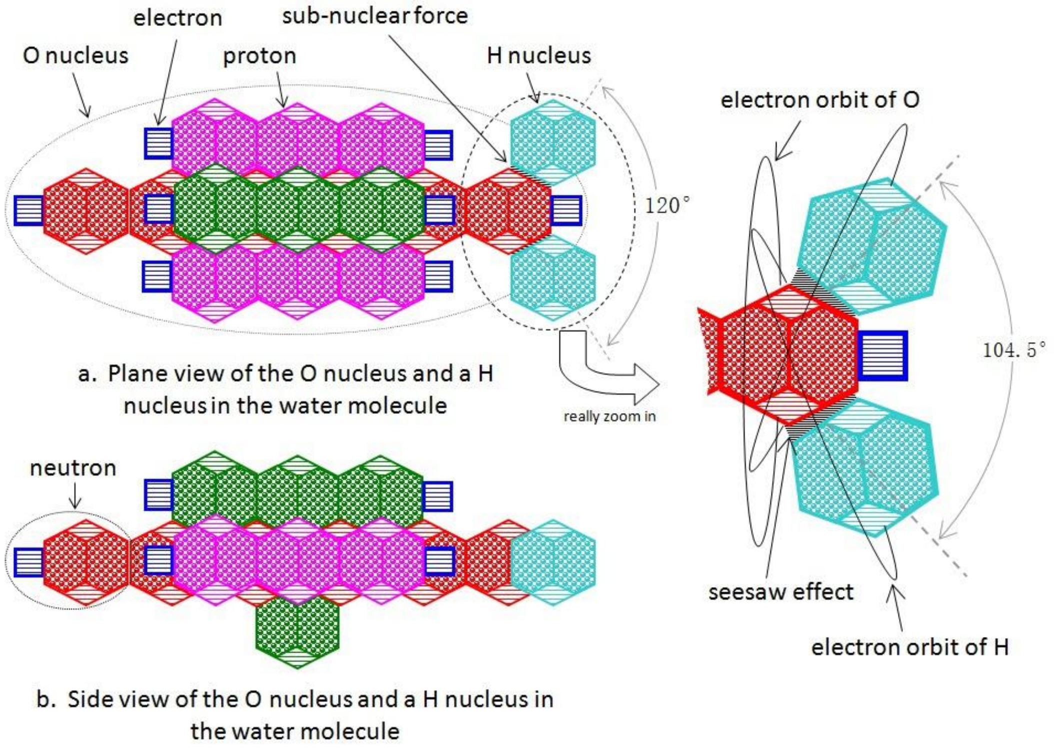


Figure 12 Schematic illustrations of the nuclear structure of a water molecule

The interaction between a H nucleus and the O nucleus includes two components. The first component is the coupling force between the neutral fields on the contact surfaces of the two nuclei. This force is similar to the strong interaction and is called the **sub-nuclear force**; it is denoted by F_m. The second component is the coupling force between the polar fields of the two nuclei (not shown in the figure; please refer to Figure 2a) and is denoted by F_p. The coupling force F between the H nucleus and the O nucleus can thus be expressed as follows:

$$F = F_m + F_p \tag{6}$$

F_p is similar to a covalent bond in chemistry, but the covalent electron does not contribute to this force. Instead, the covalent electron moves in this coupling field. It is evident that the force between the atoms in the water molecule consists of two components, namely, the internuclear neutral coupling force and the polar coupling force. It is not accurate to simply attribute this composite effect to a certain chemical bond.

Moreover, in the water molecule, nearer to the central axis of the oxygen atom, the field strength is greater. Therefore, on the action plane between the hydrogen atom and the oxygen atom, the coupling force on the side nearer the central axis is stronger than the coupling force on the side farther away from the central axis, creating a seesaw effect. This effect decreases the angle between the hydrogen nuclei. This is why the measured bond angle is 104.5°, as shown in Figure 12.

6.2 Model of the crystal structure of graphite

In modern chemistry, the crystal lattice of graphite is believed to have a layered hexagonal structure, in which there is complete layer separation and the molecular bonds dominate between the individual planes. In a graphite crystal, carbon atoms on the same layer form covalent bonds through sp2 hybridization, and every carbon atom connects to three other atoms through three covalent bonds. Six carbon atoms on the same plane form a hexagonal ring, and this geometry extends to a lamellar structure. Each layer consists of covalent crystals. Each carbon atom on the same plane has one p orbit left, and these p orbits overlap with each other. The electrons in these orbits are relatively free, equivalent to the free electrons in a metal. Therefore, graphite is thermally and electrically conductive.

The common diagram of the graphite crystal structure considers the carbon atoms as point particles, and therefore, some properties of graphite are not easy to intuitively understand. According to the carbon-atom model of the Theory of System Relativity (see Figure 10), the crystal structure of graphite can be described as illustrated in Figure 13. The C nuclei in this figure are ^{12}C nuclei, which exhibit a symmetric planar structure.

According to Figure 13, six carbon atoms form a hexagonal structure through the sub-nuclear force, and this sub-nuclear force manifests in two forms, namely, the interaction between the end faces of the internuclear protons and the interaction between the slopes of the internuclear protons. In the Theory of System Relativity, it is speculated that before the establishment of interaction between the end faces of the internuclear protons, the electron at the end falls off and becomes a unbound electron; after the interaction between the slopes of the internuclear protons is established, one of the 2p orbits is occupied (see Figure 10), and the bound electron in this orbit becomes a unbound electron. The presence of a large number of unbound electrons causes graphite to exhibit good electrical and thermal conductivity.

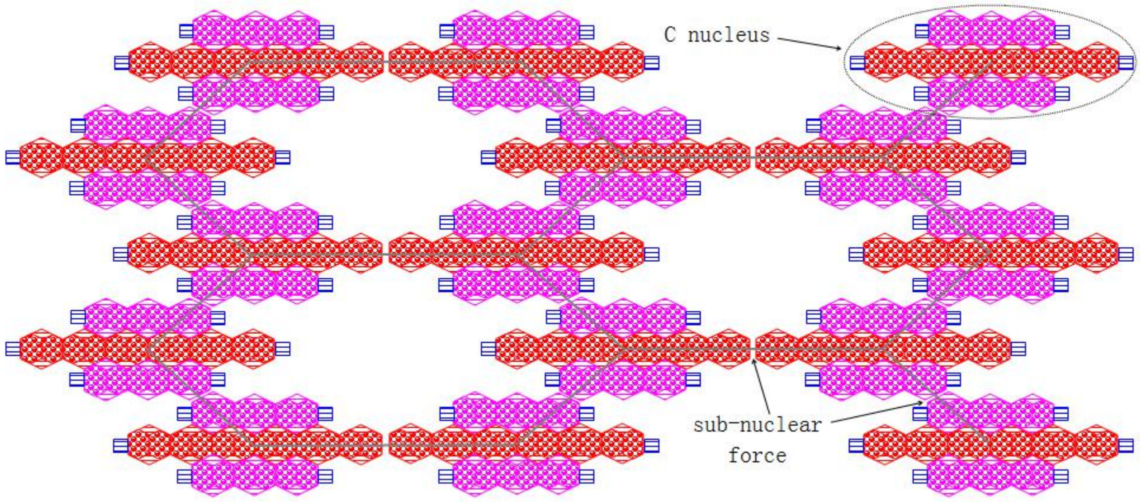


Figure 13 Model of the crystal structure of graphite

There is no direct internuclear interaction between adjacent planes, as in the modern chemical picture; instead, the primary interaction between the planes is the attraction between neutral fields. This attractive force is much weaker than the aforementioned sub-nuclear force. Therefore, the layers of a graphite crystal can be relatively easily separated. A single layer of graphite crystals is graphene, as shown in Figure 13.

6.3. Intermolecular force and states of molecules

The intermolecular force is also called the van der Waals force and refers to the interactions between molecules. In molecular physics, it is believed that when two molecules are separated by a relatively far distance, one molecule is polarized by the electric dipole moment of the other molecule, which rapidly changes with time, thus generating electric attraction, and the intermolecular force predominantly manifests as an attractive force. When two molecules are very close to each other, the outer electron clouds of the individual molecules begin to overlap, thus generating a repulsive electric force; the smaller the distance between the molecules is, the larger the repulsive force, and the intermolecular force predominantly manifests as a repulsive force.

According to the molecular model of the Theory of System Relativity, the field of a molecule is a composite field that consists of a neutral field and a polar field. Therefore, the attractive force between molecules, F_q, includes two components, i.e., a neutral coupling force F_{m1} and a polar coupling force F_{p1}:

$$F_q=F_{m1}+F_{p1} \tag{7}$$

Additionally, at the interaction surface between the molecules, there is a shearing surface [1] in addition to the coupling surface, and the shearing surface generates the mutual repulsive force F_r. Therefore, the interaction between molecules is similar to the interaction between cnons in a photon. For an object in a stable state, the attractive and repulsive forces between the molecules inside the object are mutually balanced; in other words, the force on the molecules in the equilibrium state, F, can be expressed as follows:

$$F=F_q+F_r=0 \tag{8}$$

In a solid object, every molecule continuously vibrates around a relatively fixed position, and the motion of every molecule is coordinated with and closely related to the motions of the surrounding molecules. Therefore, an object is a covariant system of the molecules it comprises.

7. Closings

What is lacking in determining the correctness of these particle models in this paper is more testing. More people are welcome to participate and criticize.

References

[1] Liu Taixiang, *the Theory of System Relativity*, SCIENTIFIC AND TECHNICAL DOCUMENTATION PRESS, Beijing: China, 2012.

[2] Liu Taixiang, An interesting model of photon. Physics Essays, Volume 28, Number 2, June 2015, pp. 203-207(5)