Studies on the formation and the nuclear structure of an atom

Author: Nakyoung Seong[1*]

Affiliations:

[1]Life and Light Institute, Seoul, 06121, South Korea.

*Correspondence to: master@lifeandlightinstitute.com (N.Seong)

Abstract: A new approach on the formation and the nuclear structure of an atom and its components are developed throughout the following paper. We provided more intuitive interpretations of the physical phenomena that can be found in the nature of the atom, which can be quite controversial with the orthodox view and the interpretations in modern physics. Readers can expect the original viewpoints and explanations on the atomic nuclei and its foundations from the three-dimensional nuclear structure of the atom and interpretations of phenomena. Most of the ideas provided in this paper can be seen as unconventional since the portions of bases are fairly the opposite of the established notions. However, the three-dimensional nuclear structure of an atom presents more plausible and practical interpretations on the physical phenomena compared to the current the field of physics can provides. Potential future applications and the necessary scientific proofs to strengthen the theories are discussed.

One Sentence Summary: A new approach on the formation and the nuclear structure of an atom and its components is discussed.

Main Text: Since the 20th century, physical phenomena for particles have been explained based on quantum mechanics observed from quantum phenomenon of light. Especially, quantum mechanics provides a different point of view on particles. Quantum mechanics regards particles as probability distribution with waves in a certain space rather than their trajectory. In other words, it is based on wave-particle duality and probability interpretations *(1)*.

In the 17th century, Isaac Newton claimed that light is consists of small particles. 2 centuries later, Thomas Young conducted the double-slit experiment or the Young's experiment provided general idea of the wave theory of light. In addition to the Young's experiment, James Maxwell's a dynamical theory of the electromagnetic field provided general acceptance of the idea that light is consists of waves *(2)*. In the beginning of the 20th century, Max Planck's law of black-body radiation, Einstein's photoelectric effect, and the Compton scattering experiment supported notion that light is composed of particles *(3)*.

At this moment, the generally accepted idea about light is wave-particle duality. This aspect of light make the light as mysterious and unique element in our universe. The Davisson-Germer experiment demonstrated the wave nature of the electron; de Broglie brought the idea further and postulated not only light has duality but all matter demonstrates properties of particles and waves. The idea is called matter waves and is also referred as de Broglie waves *(4)*, *(5)*.

Matter wave contributed as a cornerstone in quantum mechanics. One of the core principle in quantum mechanics is the Schrodinger equation. Schrodinger equation was made under the assumption of de Broglie hypothesis and the wave equation must have the wave function in order to be validated. From the solution of the wave equation, de Broglie relations were derived. In addition, Max Born reinterpreted the wave function to find probability density function *(6)*. Through such processes of validation, Schrodinger equation established the solid notion in quantum physics.

First, we will analyze the roles of particles and waves in atom and the phenomena to differentiate between particles and waves.

The force of electrons in atom and the structure of the nucleus has been quantitatively predicted through Schrodinger's equation. However, the electrons could not have any influence on the structure of the nucleus because of the uncertainty principle; therefore, the structure of the nucleus was constructed only with the elements inside the nucleus *(1)*. This idea has led to assume the total charge of the nucleus must shows positive only by the protons. Then the speculation on the repulsive force between protons led to the notion of another force besides gravitational force and the electromagnetic force *(7)*.

Especially, as binding energy per nucleon was measured throughout lab experiments, the notion of "strong nuclear force" was made to reward the extra energy needed to stabilize the nuclei.

The relation between nucleus and electron was therefore largely based on Schrodinger's equation and quantum mechanics, and the speculation of kinetic energy in electron against the attractive force of positively charged nucleus has coexisted with the Heisenberg's uncertainty principle *(8)*.

However, a considerable portion of quantum mechanical interpretation in modern physics, which was based on the matter wave, are counterintuitive and raised more questions. The interpretation of wave function as a probability density function made it harder to understand the nature of the basic particles.

Secondly, we postulate electrons as substantial particles that are exist in more rigid space and time. Furthermore, from this assumption, we conclude that electrons have a crucial role in constructing nucleus as in one-to-one ratio relation with protons.

There are many disputes coming from the nuclear structure of atoms: probability interpretation of quantum mechanics, stability of nucleus and nuclear bond and decay. To resolve these problems, we provided the three-dimensional model of nucleus arrangements to support better intuitive interpretation on nuclear binding energy and strong nuclear force *(2)*. In addition, modern nuclear physics treats the force between electrons and nucleons (Electromagnetic force) as different kind of force compared to the force between each nucleons (Nuclear force). However, we provide a perspective that these two forces are fundamentally similar and correlate to provide intuitive interpretation.

Atom and fundamental theory

Fundamental assumptions

Following assumptions are commonly used in modern physics or are found in natural phenomena.

#1. Attractive and repulsive forces are fundamental forces in the universe and are caused from electromagnetic force from the light. (In the universe, there is a repulsive force between each positive charge or each negative charge, and there is an attractive force between positive and negative charges.)

#2. As a neutron decays, it goes through a process similar to the cell division as long as it does not break the conservation of mass-energy. (Elements inside the neutron divides in binary.)

#3. A light quantum and the particles in atom interact with each other. (The force in a light quantum transfers to the particles, and the particles have a decisive effect on the light quantum.)

#4. A light quantum contains characteristic collision record/history/process as it collides with the nucleus. (More collision means higher influence on the particles, and such idea replaces the

#5. Higher temperature correlates with higher density of light.

#6. Lowest orbital energy of each atom is set by the oscillation of a light quantum between a proton and an electron.

#7. For the noble gases, the electrons in the shells around the nucleus occupy equal surface area therefore prevent access and binding of the electrons from outside. (This is the reason why the noble gases are stable.)

Neutron and Formation of atoms

A free neutron will decay with a half-life of about 881 seconds, and this process is called β^- decay. The outcome of the decay consists of proton, electron, electron anti neutrino and some extra light energy that compensates mass equivalence. The generic equation is as follows

$$\mathrm{n} \rightarrow \mathrm{p}^{+} + e^{-} + \bar{\upsilon}\mathrm{e} \quad (1)$$

From the generic equation, one can infer neutron contains the basic elements that consist hydrogen atom. Furthermore, the mass sum of the transformed particles are less than the mass of the neutron where we can find the mass difference is emitted in a light form of energy.

The electrons and protons from the neutron decay are combined together to form elements of the atom. We can apply the concept of half-life on the process between the undecayed neutron and decayed neutron. When a single neutron out of two neutrons in a pair decays, produced proton gets coupled to an undecayed neutron to become stabilized. This period can be seen as a half-life of a group of neutrons.

Thus the proton-neutron pair is considered the basic unit of a dimensionalized atom structure, and those neutrons can did not make pair decay as free neutron to compose hydrogen atom or added to the nucleus to make a radioactive isotope or stabilize the structure of the nucleus.

Beta decay of neutron

According to the experiments conducted with the particle accelerator, a neutron is consisted of two down quarks ($-\frac{1}{3}$ charge) and one up quark ($+\frac{2}{3}$ charge) to form total charge of 0, and a proton is consisted of two up quarks and one down quark to form total +1 charge.

Because the mass of u, d quarks are quite smaller than the mass of neutron, the mass in difference can be turn into another kind of particles.

In this paper, the process of beta decay for neutron is assumed as follows. As stated in the assumption #2, a free neutron goes through dividing process before it gets decayed as it does not go against the conservation of mass-energy; therefore, it duplicates each u, d quark in neutron to produce 4 d quarks and 2 u quarks in total.

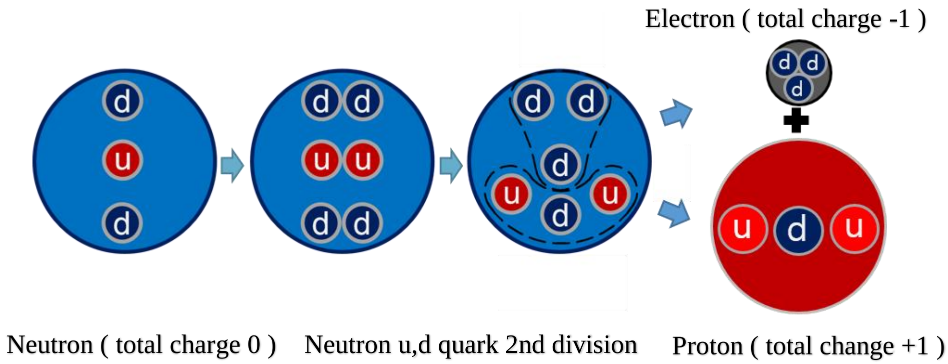

Fig. 1. the process of beta decay for a neutron. Result of the dividing process cause two u quarks and one d quark form a proton and the remaining three d quarks form an electron as it has -1 charge.

The equation of beta-minus in modern particle physics is as follows.

$$d \rightarrow u + W^{-} \rightarrow u + e^{-} + \bar{\nu}e \qquad (2)$$

A down quark forms an up quark as a W^- boson intermediates but it is only a prediction but the reason is unknown. However, instead of intermediating virtual W^- boson and weak nuclear force, the cell-division model suggests that an electron is not a fundamental particle but rather consisting of three d quarks (Fig. 1.).

The approach defies the notion of an electron as a fundamental particle, in that an electron is consists of three smaller particles.

Fundamental theory

In modern physics, the kinetic energy of an electron is considered the counter force of the electromagnetic attraction between electrons and protons to avoid the collision between an electron and the nucleus. However, we see the extra energy generated during the neutron decay as the potential energy stored in between protons and electron to counter the attractive force. The process can be seen as exothermic reaction of potential energy in shared electrons, which can be found in the quantized line spectrums for the molecular binding.

The total energy **E** of the nucleus and electrons are consisted of the sum of kinetic energy **T** and the potential energy **V**.

Hence, $E = \mathbf{T} + \mathbf{V}$ (3)

$$\mathbf{E} = \frac{p^2}{2m} + \mathbf{V(x)} \quad (4)$$

In modern physics, the counter force for the attractive force of the nucleons is considered coming from the kinetic energy portion of the equation. We considered the major force is coming from the potential energy.

If the energy emitted during beta decay is stored in between a proton and an electron, an electron would absorb energy to proceed to a higher energy level. An increase in energy level of electrons is equivalent to the potential energy is being stored in the other direction of electromagnetic attraction between a proton and an electron. Because the energy is stored in between each pair of a proton and an electron, a proton and an electron have 1:1 relation in the atom.

This principle provides an electron with a relatively more rigid role in the nucleus because electromagnetic attraction and potential energy of a light quantum balance each other to stabilize the atom without using notion of kinetic energy of electrons.

In conclusion, a proton, neutron and an undecayed neutron become the fundamental particles for the nucleus. An atom is formed and stabilized through the electromagnetic attraction and light energy emitted from the beta decay being stored as light quanta in between a proton and an electron.

Relation between particle and wave

Particles are considered substantial matter while waves are like phenomena. It can be speculated from the wave phenomena in a gas molecule and from the water molecule in nature.

When a particle (matter) in motion interacts with each particle, these particles directly and substantially influence on the particle in motion. However, the number of repeated collisions is different from the frequency in a wave. When a particle in motion influences a system with particles, they are indirectly related through transmitted energy of each particles. We consider the phenomenon that shows such relation is a wave. If it is seen as in aspect of energy, the energy of particles would be concentrated energy but the energy of wave would be dispersed energy.

Consequently, the Planck and Einstein's energy of a light quantum can be seen as the energy of the particle: $\mathrm{E} = \mathrm{h}v$

Therefore the energy of a light quantum E is proportional to the frequency which can be seen as the number of collisions during a light quantum oscillates between a proton and an electron.

In order for the assumption #3 to be valid, a light quantum needs rest mass to exert force on the particles. If a light quantum has rest mass, one can derive a mathematical expression of $\mathrm{mc}^2 = hv$ from the Einstein's mass energy equation and the energy of a light quantum. (Eq. S1.)

Assume the number of collision (oscillation) as 1, then the Planck constant h is equivalent to the energy per a light quantum where we can calculate the mass of a light quantum.

$$\mathrm{m} = \frac{h}{c^2} = \frac{6.63\times 10^{-34}}{(3.00\times 10^{8})^2} = 7.37\times 10^{-51}\ \mathrm{kg} \qquad (5)$$

At the lowest energy orbital of a hydrogen atom, say the distance between a proton and an electron is r; a light quantum, that is being oscillated, collides with each particle n times every second.

$\mathrm{n} = {}^{c}/_{2r}$ Where the number of collision per time n is equal to the frequency v.

At the lowest energy state of a hydrogen, the distance between a proton and an electron r is equal to the radius of hydrogen atom, 25 pm. The potential energy of an electron can be calculated under the assumption of the potential energy of a light quantum in between a proton and an electron is balancing the attractive force between two particles (Fig. 2.).

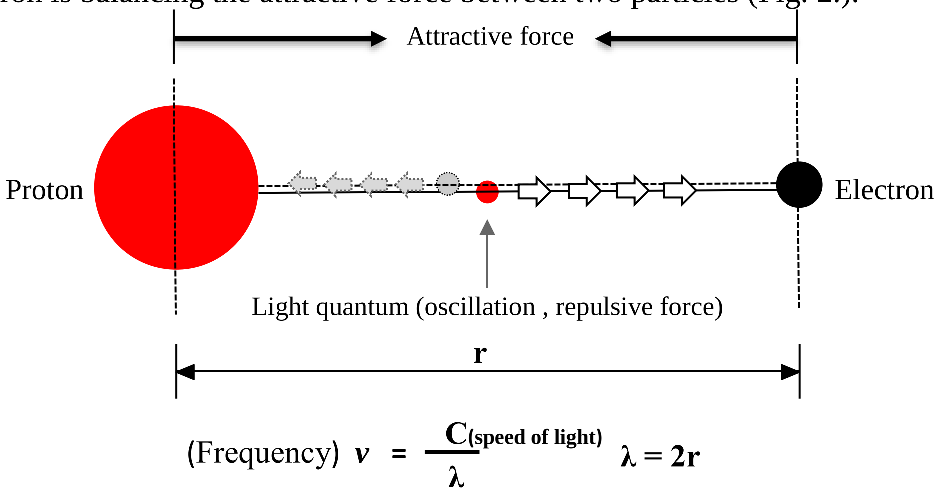

Fig. 2. Potential energy between a proton and an electron. According to the assumption #6 and the equation (6) below, the repulsive force that is due to the oscillation of a light quantum at the lowest energy orbital, 2.49×10^3 eV is preventing an electron from colliding with a proton from the attractive of a proton. However, the binding energy of a hydrogen atom at the lowest energy state is only 13.6 eV; it is much smaller compared to the repulsive force of 2.49×10^3 e. Thus from the assumption #1, an electron and a proton also get attractive forces corresponding to the oscillation of a light quantum.

$$\mathrm{E} = \mathrm{h}v = \frac{\mathrm{h}c}{2r} = \frac{6.63\times 10^{-34}\times 3.00\times 10^{8}}{2\times 2.50\times 10^{-11}} = 3.98\times 10^{-16}\ \mathrm{J} = 2.49\times 10^{3}\ \mathrm{eV} \qquad (6)$$

In addition, substituting the oscillation distance 2r to λ to get the same mathematical equation of the energy of a light quantum that is used in modern physics as v and λ are equal to the frequency and the wavelength of a light quantum.

$$\mathrm{v} = \frac{c}{2r} = \frac{c}{\lambda} \qquad (7)$$

The connotative meanings of this connection are; 1. The light itself has a wavelength and a frequency to denote the energy 2. The number of collision of a light quantum is mathematically equal to the energy of a light quantum by numerical analysis. Therefore, the viewpoint on the notion of particle and wave affects interpretation of the relations between each particle.

At higher energy orbital, an electron is too far away from a proton to have the oscillation of a light quantum; instead of having oscillation, it is now influenced by random collision of each light quantum in a certain area. The location of an electron is set by the average number of light quantum collision depending on the temperature of light due to the assumption #5.

In a homogenous system, the density and direction of light is consistent at some arbitrary point. However, inside the atom, especially where a proton (or the nucleus) and an electron is closely located, is not that consistent because the radiation of light from the nucleus have a greater influence over an electron if the path history of light follows the assumption #4. This phenomena can be seen in the energy level of an electron as the temperature of a system rises, which also means that the density of light rises. (Fig. 3.)

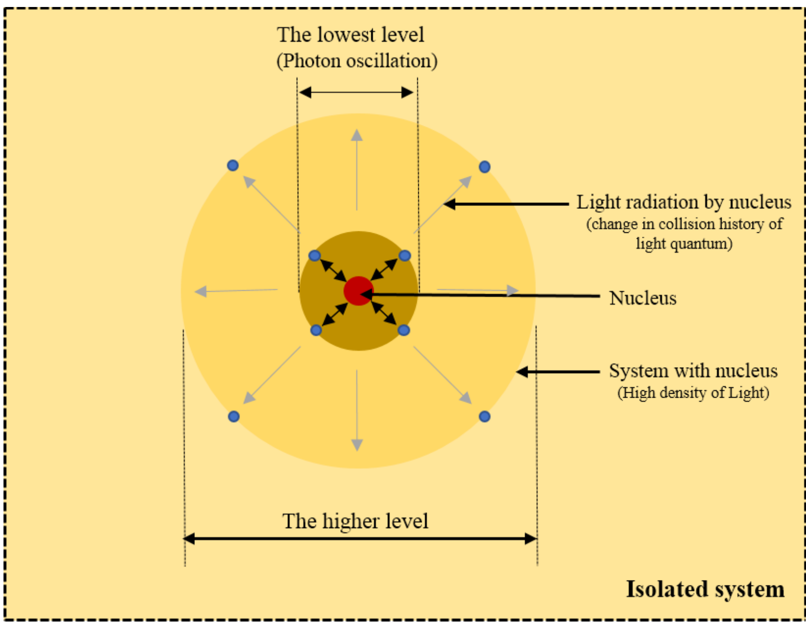

Fig. 3. Energy levels of electrons depend on temperature and an atom in an isolated system

Physical interpretation of the nuclear structure

Historical background and up-down quark

The historical background of the nuclear force is as follows:

1. Estimated binding energy of nucleon-nucleon collision is approximately about tens of MeV. However, the binding energy of electron-nucleon is only about tens of eV which is about million times smaller.
2. Electromagnetic force is generally under the concept of an electromagnetic field and radially exerts force from a single point charge; the force interacts in every direction. Therefore, when a charged particle approaches the nucleus, it could cause distortion on the structure of the nucleus due to the Coulomb force.
3. There is no equivalent nucleon with mass to electrically bind the protons in the nucleus as neutrons are electromagnetically neutral. Nuclear force is introduced to compensate this one sided electromagnetic force. It requires greater magnitude of force than gravitational and electromagnetic force to stabilize those protons in the nucleus. This is where the nuclear force is introduced and required; it has to influence the protons and neutrons at close range to bind together but not as in form of field. Nuclear force exerts in a close range and has greater magnitude of force to keep the nucleus spherical.

Modern nuclear physics provides a comprehensive explanation of the structure of nucleus by assuming that the nuclear force is acting in the opposite direction of the repulsive force between each proton *(3)*. This assumption should stabilize the nucleon as it gets more neutrons in the atom. However, this is not true. Most of the isotopes are stabilized only when it contains specific number of neutrons. For some cases, it rather gets destabilized as it gains more neutrons.

Additionally, because the shape of nucleus has to be deduced only by using the nucleus, it only projects sphere-shape and could not predict various forms of nuclides that are produced during the decay. It does not provide sufficient scientific explanation of why only specific nuclides are produced.

Instead of intermediating nuclear force, assume the Coulomb force between u, d quarks in a proton and a neutron stabilizing the nucleus (Fig. 4.). 10MeV of magnitude of binding energy can be explained in this way because the distance between the electron and the nucleus is about 10^6 further than the distance between each nucleon. Even though the electromagnetic force of u, d quarks in a neutron and a proton exerts in every direction, the Coulomb force is inversely proportional to the distance between two point charges (quarks in this case). This is the reason why a nucleus holds its stability without any force acting from outside the atom.

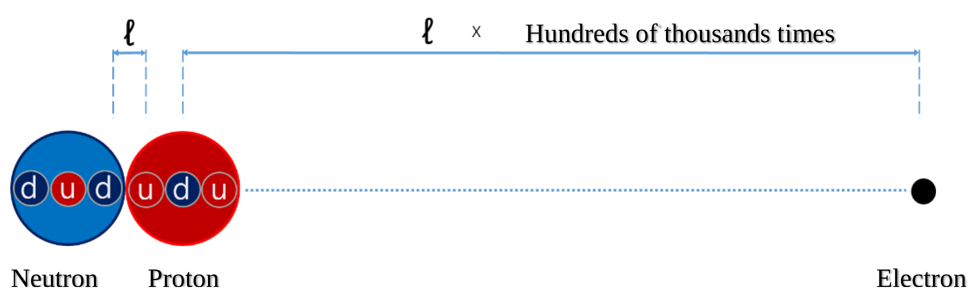

Fig. 4. u, d quark binding of a neutron and a proton, and the distance between proton and electron

Therefore, neutrons and protons are stacked up by turns in the nucleus. In this process, the number of protons is equal to the number of electrons; however, the number of neutrons varies according to the three dimensional model of nucleus for stability. It requires more neutrons to stabilize the nucleus when it is three dimensionally unstable. Remember a free neutron is going through beta-minus decay in nature which creates extra neutrons. That will make the nucleus more unstable since it contains extra neutrons (than if it binds each nucleon).

Overall, neutrons are located between each proton to reduce the electromagnetic repulsion. It takes role of adhesive between each nucleon to stabilize the nucleus. At the same time, when it has excess neutron, it goes through beta decay to destabilize the nucleus.

Binding model of alpha particle in Horseshoe magnet shape

Based on the bond of each nucleon and duality of neutrons, consider the alpha particle (and the nucleus of ^{4}He) as the base unit of constructing stabilized nucleus. The structure of the nucleus can be designed by using this unit.

Electromagnetically, it contains +2 charge and positions quarks as in multipole shape to maintain stabilization (Fig. 5.). In this way, the electromagnetic repulsion between two protons can be neutralized without intermediating nuclear force to bind the protons and neutrons.

In other words, as each 6 u, d quarks are bound by the attractive force, the boundaries of protons and neutrons get vague and become square-ring and horseshoe magnet shape. If the electromagnetic repulsion acting between these quarks can be seen as strong nuclear force, it only requires the light quantum and the light that intermediates electromagnetic force to explain such phenomenon. Then the exchange particles for the strong force is not required at all.

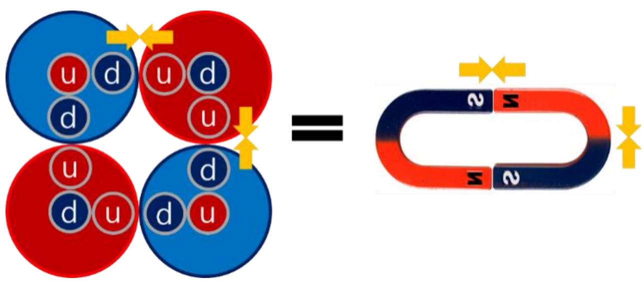

Fig. 5. u, d quark distribution in alpha particle and the horseshoe magnet shape binding model

The nuclei structures of noble gases can be constructed by stacking up ^{4}He nuclei as they have a base unit of alpha particles and only differ by atomic weight. The nucleus of Neon, which is the next heavier noble gas, can be constructed by stacking additional alpha particle in perpendicular. The notion of weak nuclear force can be seen in the structure of a nucleus of neon if the perpendicularly contacted alpha particles are farther than those are in horizontal contact (Fig. 6.).

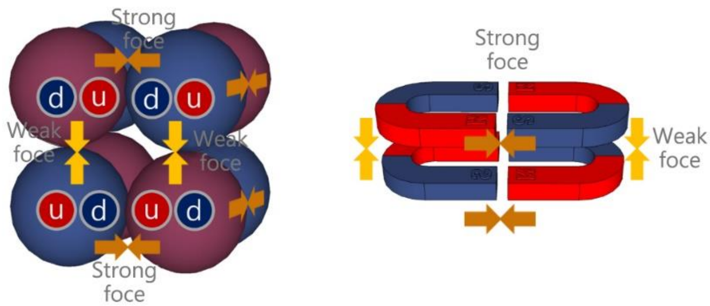

Fig. 6. Strong and weak force of nucleon in alpha particle

Interaction between electrons and nucleons

In order to understand the three dimensional structure of nucleon, it requires different approach where one visualizes the structure of nucleus by using the binding energy. It is currently impossible to directly observe the nucleons except for colliding particles in modern physics. Thus the existing method based on the binding energy will not be used in this paper. Consequently, we will approach and build the nucleus structure from the arrangement of atomic electrons, where the arrangement of the nucleons is deduced from the arrangement of atomic electrons.

The major force that stabilize the structure of the nucleus is the electromagnetic force, and the force between the nucleons and electrons are also the electromagnetic force. Therefore, the interaction between each nucleon is essentially as same as the interaction between an electron and a nucleus. Then it can be inferred that the nucleus should have a connection to the arrangement of electrons in an atom.

The exact relationship between the arrangement of electrons and nucleons is unknown. Nonetheless, the neutron decay causes a proton and an atomic electron to be paired in with a light quantum to be stabilized and moving in a set. Thus the structure of nucleus is closely related to atomic electrons, and it is possible to estimate the structure of the nucleus from the arrangement of electrons.

Electrons only affect the early process of forming the nucleus in atom. As the nucleus is fully formed, the bonds of each nucleon get too strong for electrons exert any influence. Therefore, even if the atom was ionized or the arrangement of electrons changed during the process, the electrons would not affect the structure of the nucleus in any form.

The atomic nuclei of the noble gases

Before comparing the stability of every single atomic nucleus exist in the universe, with the table of nuclides, it is efficient to construct the atomic nucleus model for the noble gases in order to construct the models for the other elements in each period in the periodic table. For example, period 2 elements Li, Be, B, C, N, O, F can be made by stacking up particles from the alpha particle until it becomes Ne.

Most of the time, the noble gases have degree of freedom equal to the number of neutrons in nature. It doesn't necessary to have 1:1 ratio of a proton and a neutron to hold a stabilized nucleus. However, for simplification of the three dimensional model, assume 1:1 ratio.

For the atomic nuclei heavier than Ar, it is not realistic to have 1:1 binding compared to the actual element. Therefore, we will take the model of Rn to carefully examine the effect of extra neutrons on the structure of nucleus and possibility of decay.

The sequence of how to make the structure of nucleus is as follows

1. A neutron, proton and an electron consist a single set in an atom.
2. The electrons in the outermost shell are located evenly around the shell as in spherical shape.
3. After the location of electrons are fixed, the protons are placed in the same direction with a neutron next to existing proton.
4. At the end of each period, the electrons in the previous period are approaching the nucleus by the electrons in the next period and are relatively strongly fixed.
5. Accordingly go through the same sequence for each period.

Period 2 element; Neon (^{10}Ne)

With the atomic nucleus of He as the center, place two layers of alpha particles on and under the alpha particle in the center. The model then would contain five layers of protons and neutrons. Because the protons and neutrons in alpha particles are placed in turns, the square ring shaped quarks in the particles would have stronger bond compared to the bond between each other layer. As a result, relatively weak perpendicular bonds enable the nucleons to form a square pillar shape (Fig. 8.). Total charge is estimated as +10 based on the number of neutrons and protons. At this point, the center layer contains 2 electrons from period 1, and the other remaining 8 electrons in period 2 are paired with 8 protons and placed in each 8 vertex on each 6 side of sphere (Fig. 7.).

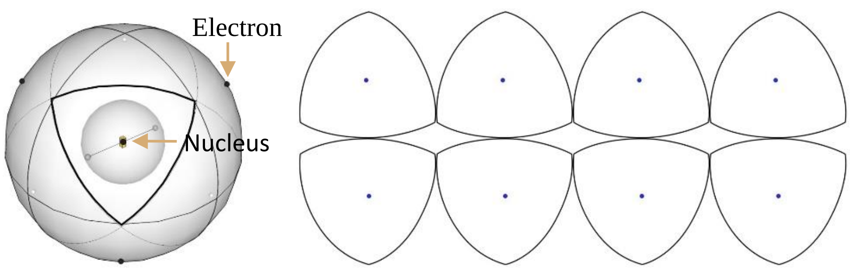

Fig. 7. Period 2 element; Neon (^{10}Ne) the electron placements in the outermost shell on a planar figure.

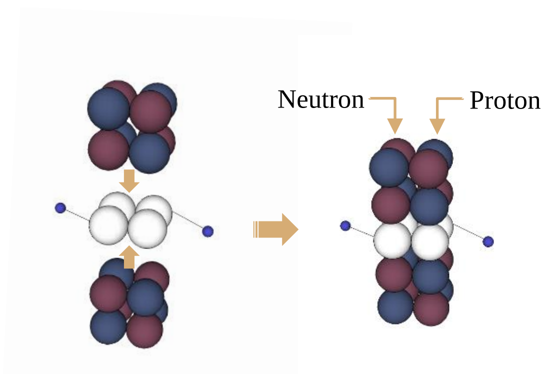

Fig. 8. Period 2 element; Neon (^{10}Ne) the structure of nucleus

Period 3 element; Argon (^{18}Ar)

In case of Ar, the structure of nucleus must form from the nucleus of Ne and obeys the octet rule in order to bind the extra 8 electrons from period 3. As we have stated in the sequence of making the nucleus structure, the arrangement of electrons and the arrangement of nucleons interact each other; therefore blindly stacking alpha particles in a square pillar shape would contrary to the hypotheses. Thus, the structure needs to be in symmetry and the electromagnetic repulsion between each proton must be minimized at the same time. In order to achieve the conditions, place the 8 proton and neutron pairs as farther away as possible.

Finally, the arrangement of period 3 electrons must be in a stable location with great consistency. 4 pairs of protons and neutrons can be placed as shown (Fig. 9. And Fig. 10.).

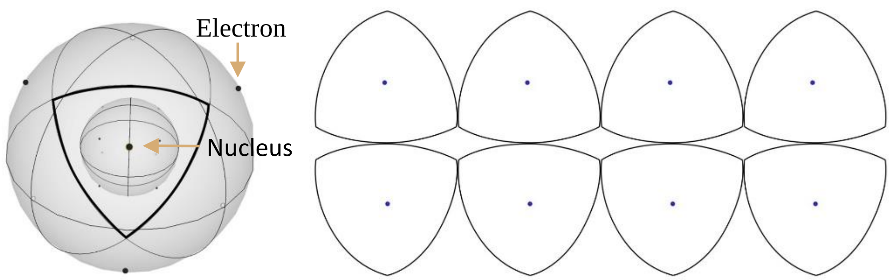

Fig. 9. Period 3 element; Argon (^{18}Ar) the electron placements in the outermost shell on a planar figure.

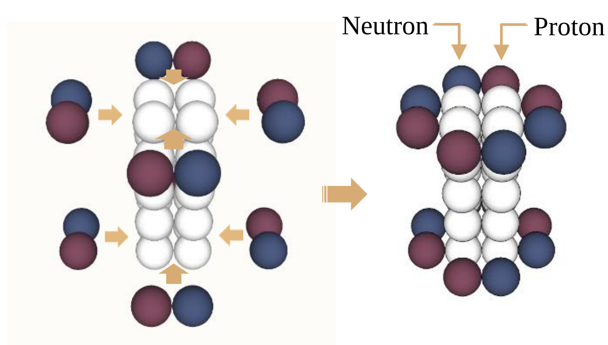

Fig. 10. Period 3 element; Argon (^{18}Ar) the structure of nucleus.

Period 4 element; Krypton (^{36}Kr

The outermost electrons become total 18 at the period 4. Therefore, total 18 pairs of protons and neutrons should be added. There can be more than two arranging method, but in order to place 18 electrons in balanced location, every 3 electrons must be placed in each 6 side of the sphere (Fig. 11.). 3 proton-neutron pair must also be placed in every each side as the pairs are in 1:1 relation with electrons (Fig. 12.).

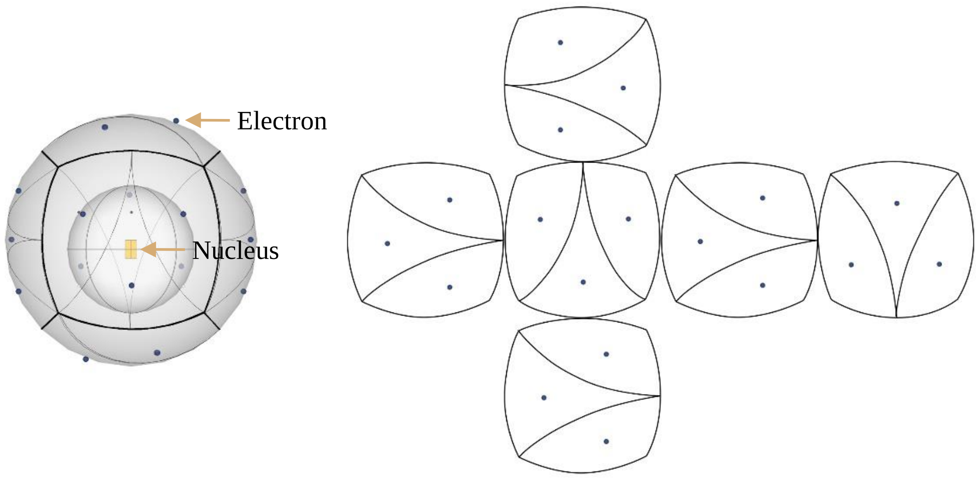

Fig. 11. Period 4 element; Krypton (^{36}Kr) the electron placements in the outermost shell on a planar figure.

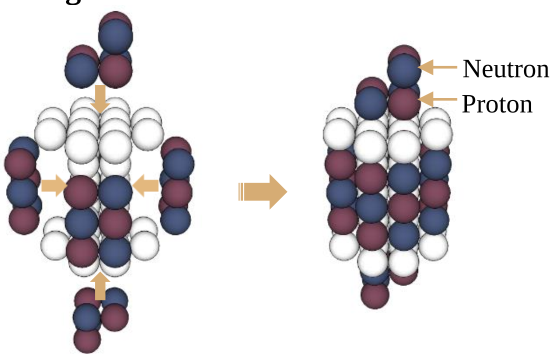

Fig. 12. Period 4 element; Krypton (^{36}Kr) the structure of nucleus>

Period 5 element; Xenon (^{54}Xe)

The same process of adding 18 pairs of proton and neutron that has been used in ^{18}Ar to ^{36}Kr transform is used again. At the end of adding pairs, the structure has the perfect center of symmetry in the middle (Fig. 13. And Fig. 14.).

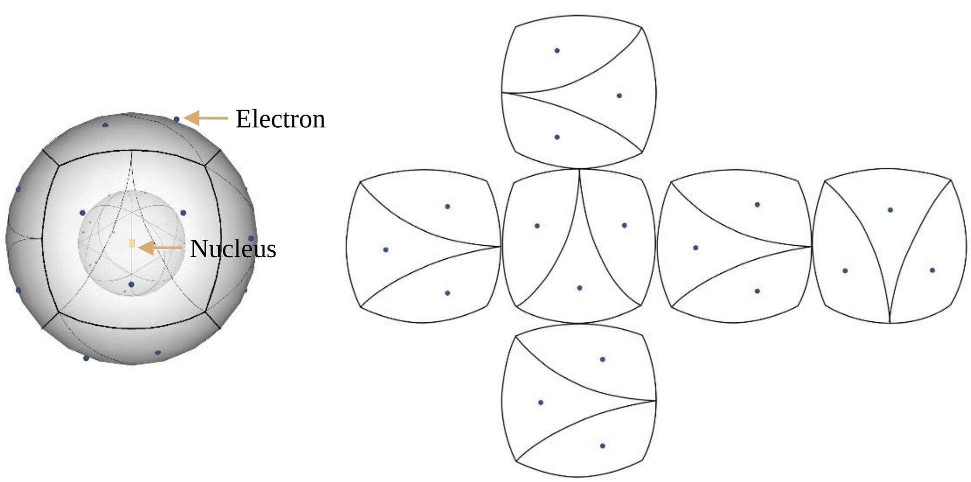

Fig. 13. Period 5 element; Xenon (^{54}Xe) the electron placements in the outermost shell on a planar figure.

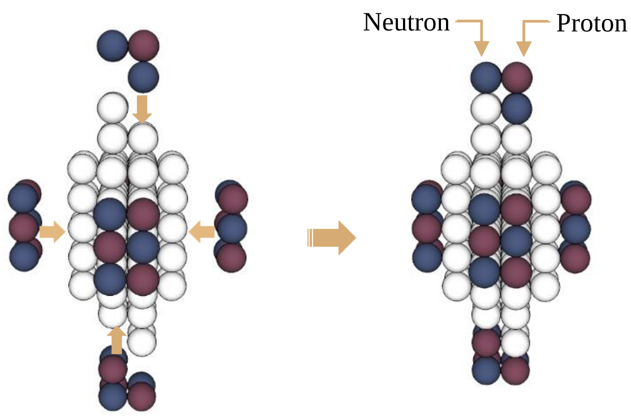

Fig. 14. Period 5 element; Xenon (^{54}Xe) the structure of nucleus.

Period 6 element; Radon (^{86}Rn

The outer shell electrons for ^{86}Rn is 32, and 4 electrons are needed to be placed in each 8 vertex on each 6 side. Adding correspond neutron-proton pair to the nucleus of ^{54}Xe would look like the image on the right; total 32 pairs, 4 pairs of neutron-proton particles, are required on every 8 corner of the nucleus structure (Fig. 15.).

Rn is one of the radioactive isotopes exists in nature. Such unique characteristic is reflected as 32 pairs of neutron-proton particles are being added at every corner of the nucleus of ^{54}Xe. Geometrically, 4 of each 8 pairs of neutron-proton particles are unstably bound to ^{54}Xe so that it can be decayed unstably.

Only the Rn with mass number 222 exists under normal condition. The reason why ^{222}Rn exists as the most stable isotope is that the 50 extra neutrons that ^{222}Rn have are placed in between each unstable protons for ^{172}Rn. Referring to the image of nucleus structure of ^{222}Rn on the right to have a better understanding of placing neutrons. Add 16 neutrons (white) on where the 3 protons are being connected, add 10 neutrons (yellow) to connect 2 protons, and add 24 neutrons (light blue) on where the last proton is being connected. By adding the total of 50 neutrons to have a stable isotope ^{222}Rn from a ^{172}Rn. Extra neutrons to bind on the nucleons at each 8 corners could help stabilizing the structure (Fig. 16.). However, those neutrons that are not fully bound as neutron-proton pairs in three dimensional model have a tendency to go through neutron decay.

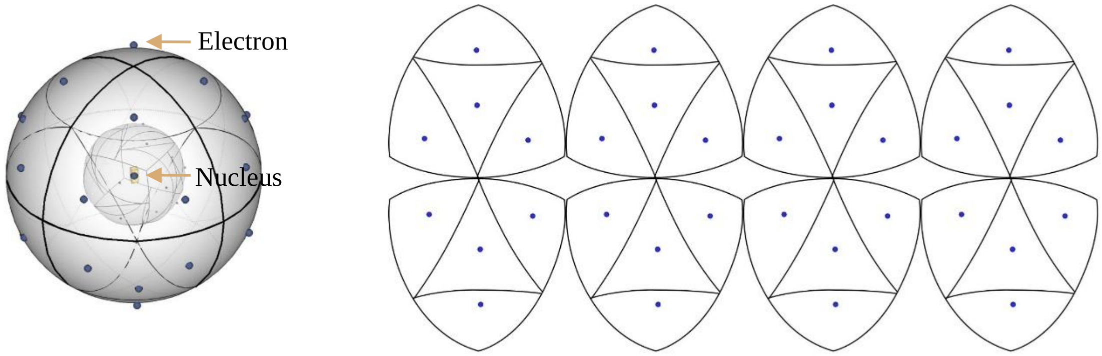

Fig. 15. Period 6 element; Radon (^{222}Rn) the electron placements in the outermost shell on a planar figure.

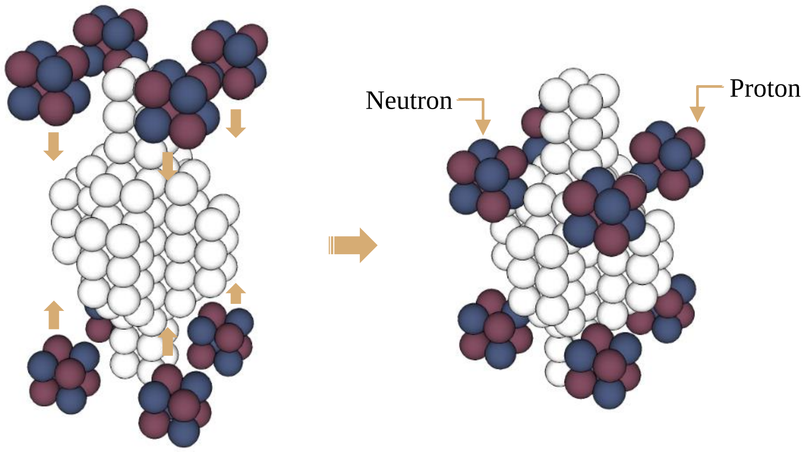

Fig. 16. Period 6 element; Radon (^{222}Rn) the structure of nucleus.

Period 7 element; Ununoctium (^{118}Uuo)

The last noble gas element ^{118}Uuo (Fig. 17.) does not exist under normal condition. It is very unstable so that even artificially created nucleus decays in few seconds. The biding method is identical to that for ^{222}Rn. By adding neutron-proton pairs at each 8 corners to create a three dimensional model of ^{118}Uuo (Fig. 18.). The standard atomic weight for Uuo is 294 then subtract atomic mass 236 to get 58 neutrons to assign as same as we did in the case for ^{222}Rn.

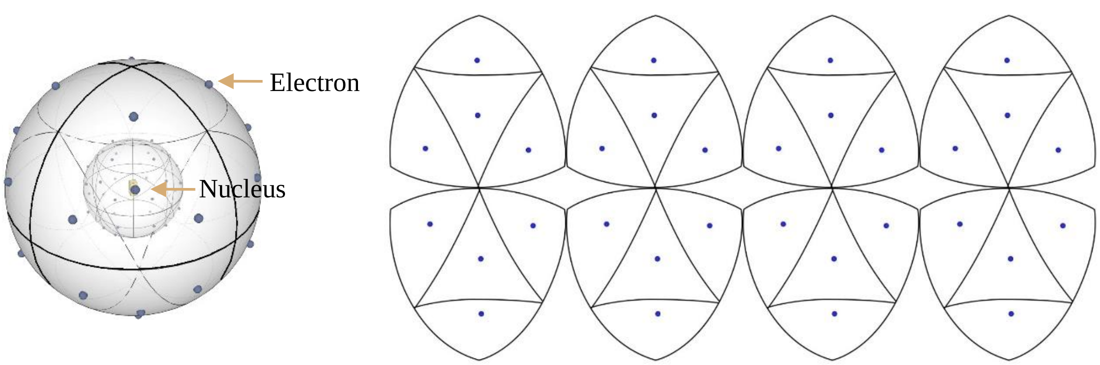

Fig. 17. Period 7 element; Ununoctium (^{118}Uuo) the electron placements in the outermost shell on a planar figure.

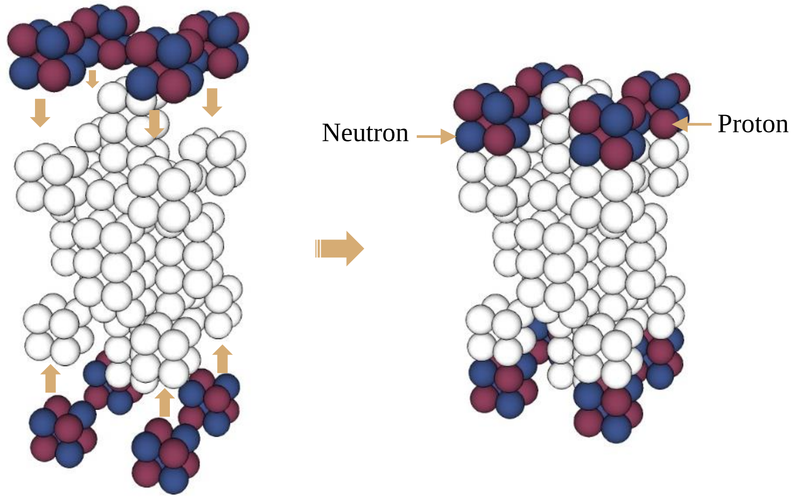

Fig. 18. Period 7 element; Ununoctium ^{118} (Uuo) the structure of nucleus.

Analysis of the physical phenomena

Number of neutrons in atom

Most atoms have the same number of protons and electrons; however, the number of neutrons are either same or more than the number of protons. The reason such phenomenon is frequently found in many atoms is because of the stability of the nucleus structure. As you can see in the structure of nucleus models, if an atom has an excessive neutron, the atom either would exist as a radioactive element or would have to go through the neutron decay. The higher number of neutrons in an atom can be explained through the interpretation of this phenomenon.

General prediction of specific atom production under nuclear fission

There are various nuclei that has split from the nuclear fission of ^{235}U but it is limited to certain atoms. The reason why atoms like ^{54}Xe appears the most is because geometrically ^{54}Xe has symmetric axis at the center of the nucleus so that is hard to get nuclear fission. However, 8 pairs of nucleons on each corner of ^{86}Rn easily fall off because of neutron collisions.

Additionally, given that ^{55}Cs has a higher number of nucleons than ^{54}Xe, the three dimensional model can explain why specific atoms are produced in combination except for the nucleons of ^{54}Xe, through nuclear fission.

The nuclear fission of uranium

^{235}U undergoes relatively easy nuclear fission by a neutron collision, however ^{238}U does not split but rather bind to form a plutonium. Because ^{222}Rn easily tends to decay in nature because of its structure while ^{238}U has 6 higher atomic number than ^{222}Rn but has 4 more nucleons in addition to the 12 neutron-proton pairs which makes it bind strongly with the nucleus of ^{54}Xe. On the other hand, ^{235}U has 3 less neutrons compared to ^{238}U, and this difference causes the nucleons on 8 vertex to easily fall off by neutron collisions.

Radioisotopes

The atoms in the same atomic number but with different mass are considered as isotopes, and the atom either contains more or less number of neutrons. The isotopes with higher number of neutrons can go through nuclear fission affected by the neutron decay. The isotopes with lesser number of neutrons are structurally weakly bound so that it may emits radioactive rays as a neutron decays. Analyzing the three dimensional model of nucleus would help one to understand.

Quark of an electron

As stated in the assumption #2, an electron has produced in the process of a neutron decay, and the electron has to consist of three d quarks. In modern physics, electron is assumed as the fundamental particle however, an electron may consist of three different quasiparticles according to recent research *(9-12)*.

Binding energy of the atomic nucleus

At the moment, most of nuclear binding energy of the atomic nuclei are experimentally measured. It is well-known to derive the binding energy per nucleon by dividing the binding energy of atom over the number of its nucleon.

The size of binding energy per nucleon depends on the number of protons, especially distinguishable when the numbers are either even or odd. The reason behind this phenomenon may deduced from the He shape binding. When the number of protons is even, the quarks in protons and neutrons bind like the alpha particle. However, when the number of protons is odd, neutron-proton pair does not bind like the alpha particle; therefore, the pair exists separately from the alpha particle and has relatively weaker binding between each other.

Conclusion

Every matter in the universe consists of molecules, and the molecules are made out of combination of the atoms. The combination of atoms requires involvement of the electrons, where we can reassess the electrons as substantive objects rather than by using the probabilistic method.

The presence of electron is measured through the probability density function, and the interpretation of it is that the existence of electrons are set by probability. For the ground state of hydrogen, the presence of electron is increase until Bohr radius and peaked at it then decrease.

Presence of very fundamental element like electron cannot just set by probability. Of course throughout many experiments we can see it is shown just like probabilistic model, however the expected model that is cited in this paper shows the behavior. The main difference between the probabilistic model and the expected model is coming from how we see the light energy in the atom.

It is the reason why we provide different point of view in the atoms. All aspects of the atom stems from the field of physics in the 19th century. The connection to the potential energy in atom could not be settled then. Not enough scientific evidence supports the kinetic energy as the main interest for the atom. Therefore, we provided a point of view that the potential energy can be the main energy that keeps the electron from colliding to the nucleus. Especially the potential energy of the quantum of light, photon or the light quantum, as the medium between protons and electrons.

The three dimensional model of nuclear structure of the atom is developed based on those assumptions and theories. The binding energies, nuclear forces between each particles and number of neutrons in atoms have been interpreted more intuitively. The intervention of virtual gluon during beta decay is also unnecessary when using the assumption of the electron is indeed reducible particle and which is consisted of three smaller particles *(9-12)*. If the author is proved correct, and it is consisted of three down quarks, it would prove one of the most important hypothesis. The notions of structure of atomic nucleus and electromagnetic force in atom will lead to another foundation of gravity.

The atomic structure is highly dependent on Heisenberg's uncertainty principle and, which is, on certain level, counterintuitive. Physics should be about the interpretation of phenomena we can see in nature whether it is at microscopic level or bigger. The physical interpretation provided in this paper offers more in-depth and practical explanations. It is time to reassess the established notions that we have accepted as facts and back track to see where is the missing link. As the assumptions and theories are being proved true, we can get close to the essence of gravity as in forms of electromagnetic energy.

References and Notes:

1. Einstein, A. Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt. *Annalen der Physik* **17** (6): 132–148 (1905).
2. Maxwell, James Clerk. A dynamical theory of the electromagnetic field. *Philosophical Transactions of the Royal Society of London.* ***155**: 459–512.*
3. Compton, Arthur H. A Quantum Theory of the Scattering of X-Rays by Light Elements. *Physical Review* **21** (5): 483–502 (May 1923).
4. de Broglie, L., Recherches sur la théorie des quanta, Thesis (Paris), 1924; L. de Broglie, *Ann. Phys. (Paris)* **3, 22** (1925)
5. P. Atkins, J. D. Paula, *Physical Chemistry Seventh Edition* (Oxford, Seoul, 2004), **341**.
6. Born, M. "Quantenmechanik der Stoßvorgänge". *Zeitschrift für Physik* **38 (11–12): 803– 827** (1926).
7. R. P. Feynman, *The Feynman Lectures on Physics* **Vol Ⅰ** (Seung San, Seoul, 2004), 38.
8. Kugel, K. I. & Khomskii, D. I. *Sov. Phys. Usp.* **25**, 231–256 (1982).
9. Kim, C. et al. *Phys. Rev. Lett*. **77,** 4054–4057 (1996).
10. Schlappa, J. *et al*. *Nature advance online publication* http://dx.doi.org/10.1038 **/nature10974**
11. Shimojima, T. *et al*. *Science* **332,** 564–567 (2011).

Acknowledgments: We thank the staff at Life and Light Institute for making necessary figures and English translation. **Funding:** Life and Light Institute, Seoul, 06121, South Korea. $2,000 in total for making graphics, English translation and editing this paper. **Author contributions:** N.Seong is a sole author of this article. **Competing interests:** Author declares no competing interests. **Data and materials availability:** All data is available in the main text or the supplementary materials.