COMPLETE UNDERSTANDING OF NEUTRON, DEUTERON, ALPHA PARTICLE AND NUCLEI - A NEW APPROACH

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Regarding neutron, numerous questions arise, e.g.: 1. A neutron happens to be unstable in its free state and becomes stable in stable nuclei and systems (e.g. deuterons and α particles), but why and how? 2. What does happen or situation is created in stable nuclei/systems such that the neutrons become stable in them? 3. Why and how is that situation not being created in nuclei/systems having, e.g. two-neutrons, three-neutrons and one-proton etc.? 4. Why and how does neutron have unstable and stable, both the states, while the rest of all the elementary particles have only one state, either stable or unstable? 5. Why and how does neutron survive for time t = 885.7 ± 0.8 seconds (mean life time of neutron) and then decays, while the rest of all the unstable elementary particles decay within fraction of a second? But the standard quark model and the other neutron models fail to give explanation of the above questions. Therefore, presently a new model for neutron structure has been proposed that gives clear and complete explanation of all the above questions along with very clear and complete explanation of the following numerous greatly important phenomena/events: 1. Why and how β particles, which are electrons, are emitted from the nuclei during β decay while it is believed that the electrons do not reside inside the nuclei; 2. Why and how energy of the emitted β particles varies in the form of a continuous energy spectrum; 3. Why and how the neutrons have high penetrating power and distinguishable low and high-energy ranges; 4. How one-neutron and one-proton are arranged in a deuteron such that a binding force is generated between them which persists and consequently deuteron exists in nature; 5. Why and how di-proton and di-neutron do not exist in nature; 6. Why and how binding energy per nucleon (E_b) of H^3 and He^3 are increased to > $2\times E_b$ of deuteron, and E_b of $H^3 > E_b$ of He^3; 7. Why and how H^3 is radioactive, decaying into He^3 through β decay; 8. How two-neutrons and two-protons are arranged in an α particle such that it persists and behaves like a particle and beams of α particles are obtained despite having repulsive Coulomb force between them; 9. Why and how E_b of α particle is increased to > $6\times E_b$ of deuteron, instead of increasing to $2\times E_b$ of deuteron; 10. How are nucleons arranged in nuclei having mass number (A) integer multiple of 4 such that the nuclei are most strongly stable; 11. Why and how E_b of $Be^8 < E_b$ of He^4, while E_b of nuclei increases as their A increases; 12. Why and how other nuclei are not strongly stable; 13. Why and how near A = 62, E_b is maximum and then it gradually decreases as A increases and ultimately for A > 200, the nuclei become radioactive and α, β, γ, ν are emitted from them; 14. How γ and ν obtain particle like physical existence and so high energy and penetrating power. These explanations give almost a complete understanding of neutron, deuteron, α particle and nuclei (structure, stability and decay). Finally: 1. An important conclusion has been drawn that the strength of stability of a nucleus does not depend only upon its E_b but also upon the strength of stability of its neutrons because the later one too varies; 2. The existence of antineutrino has been question marked.

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1. INTRODUCTION

It is believed that the neutrons are unstable in their free state, but in stable nuclei/systems (e.g. deuteron, α particle), they become stable. But it raises question, do the neutrons become stable due to the stability of nuclei/ systems, or in stable nuclei/systems, since the neutrons become stable, consequently the nuclei/systems too become stable? If the former part of the above question is true, the question arises, how due to stability of nuclei/systems, do the neutrons become stable? If the later part is true, the question arises, how do the neutrons become stable and how consequently do the nuclei/systems become stable?

It is also believed that the β particles are emitted from the unstable nuclei, not from the stable nuclei. But it raises several questions, e.g., do the nuclei become stable and hence the β particles stop emitting from them, or when the β particles stop emitting, is it assumed that the nuclei become stable? Secondly, how and from where are the β particles emitted? If, according to quark model [1], the β^- particles are emitted from the neutrons as the consequence of decay of their down quarks into up quarks and the β^+ particles are emitted from the protons as the consequence of decay of their up quarks into down quarks, then the protons too should have unstable and stable both the sates as the neutrons have. But, on the contrary, the protons are always stable.

There are numerous such questions but we find their no explanation. The quark model [2, 3] is supposed to be the standard model of particle physics, but that too fails to give explanation of these questions.

Further, we find almost no explanation of: 1. Why and how β particles, which are electrons, are emitted from the nuclei during β decay while it is believed that the electrons do not reside inside the nuclei; 2. Why and how energy of the emitted β particles varies in the form of a continuous energy spectrum; 3. Why and how the neutrons have high penetrating power and distinguishable low and high-energy ranges; 4. How one-neutron and one-proton are arranged in a deuteron such that it persists and hence exists in nature; 5. Why and how di-proton and di-neutron do not exist in nature; 6. Why and how binding energy per nucleon (E_b) of H^3 and He^3 are increased to > $2\times E_b$ of deuteron, and E_b of $H^3 > E_b$ of He^3; 7. Why and how H^3 is radioactive, decaying into He^3 through β decay; 8. How two-neutrons and two-protons are arranged in an α particle such that it persists and behaves like a particle and beams of α particles are obtained despite having repulsive Coulomb force between them; 9. Why and how E_b of α particle is increased to > $6\times E_b$ of deuteron, instead of increasing to $2\times E_b$ of deuteron; 10. How are nucleons arranged in nuclei having mass number (A) integer multiple of 4 such that the nuclei are most strongly stable; 11. Why and how E_b of $Be^8 < E_b$ of He^4, while E_b of nuclei increases as their A increases; 12. Why and how other nuclei are not strongly stable; 13. Why and how near A = 62, E_b is maximum and then it gradually decreases as A increases and ultimately for A > 200, the nuclei become radioactive and α, β, γ, ν are emitted from them; 14. How γ and ν obtain particle like physical existence (as the electrons have, otherwise, the collisions between electrons and γ photons and hence the Compton's effect cannot take place) and so high energy and penetrating power.

Few phenomena have been tried to explain using the quark model, but there arise numerous such questions which raise serious question mark over the truth of this model (see section-3.9).

The present model gives very clear and complete explanation of all the questions mentioned above and in the abstract, and of all the phenomena/events mentioned above (see sections-3 to 9). [The rest of other properties of neutron, deuteron, α particle and nuclei, and the related phenomena/ events too can be explained.] These explanations give almost a complete understanding of neutron, deuteron, α particle and nuclei (structure, stability and decay).

2. THE PRESENT MODEL

The electron possesses magnetism by virtue of nature similarly as it possesses its charge -*e* by virtue of nature (see reference-4). This magnetism occurs in the form of a circular ring, shown by a dark solid line circle, Fig. 1, around the charge of electron, where the charge has been shown by a spherical ball, Fig. 1(a), and by a thick dark circle, Fig. 1(b). Around the magnetic ring, there occurs magnetic field. The magnetic ring and the ball of charge of the electron both spin but in directions opposite to each other. (How and from where the magnetic ring and the ball of charge of the electron obtain their spin motion and how their spin motion persists, see reference-4.) The spin (intrinsic) magnetic moment (μ_s), which the electron possesses, arises due to the spin motion of its magnetic ring and occurs in the direction of spin angular momentum of the magnetic ring L_{sm} (see reference-4). The existing concept that μ_s of electron arises due to spin motion of its charge -e is not true [4].

The frequencies of spin motions of the ball of charge and of the magnetic ring of the electron happen to be such that the spin angular momentum of the ball of charge of electron L_{sc}, is greater than the spin angular momentum of the magnetic ring of electron L_{sm}. The spin angular momentum L_s, which the electron (as whole) possesses, happens to be the resultant of these two, i.e. $\boldsymbol{L_s = L_{sc} - L_{sm}}$. Consequently the electron possesses its linear motion in the direction of spin angular momentum of its charge, i.e. in the direction of L_{sc} (because the spinning particles, e.g. electron, proton etc. possess linear motion in the directions of their respective spin angular momentum, see reference-5).

The proton too possesses magnetism by virtue of nature in the form of a circular ring around the charge of proton similarly as the electron possesses, Fig. 1, and this magnetism and the charge of proton both spin in directions opposite to each other. The magnetic moment (μ_s), the proton possesses, arises due to the spin motion of its magnetic ring and occurs in the direction of spin angular momentum of the magnetic ring (L_{sm}). The frequencies of spin motions of the ball and of the magnetic ring of the proton happen to be such that the spin angular momentum of magnetic ring (L_{sm}), is lesser than the spin angular momentum of the ball of proton (L_{sc}). Consequently the spin angular momentum $\boldsymbol{L_s}$, which the proton (as whole) possesses, happens to be = $\boldsymbol{L_{sc}}$ - $\boldsymbol{L_{sm}}$, and the proton possesses its linear motion in the direction of spin angular momentum of its ball (L_{sc}). The frequency, say ω', corresponding to resultant spin angular momentum L_s of proton, happens to be the actual frequency, which the proton possesses.

The magnetic moments (μ_s) of electron (μ_{se}) and proton (μ_{sp}) depend upon: 1- Amount of magnetism in their magnetic rings; 2- Frequencies of spin motion of their rings. The frequency of spin motion of the magnetic ring of the electron (and similarly of proton) depends upon the magnitude of interaction between the magnetic and electric fields respectively of magnetic ring and of the ball of charge of the electron (and proton). And the magnitude of interaction depends upon: i- Amount of charge in the ball; ii- Frequency of spin motion of the ball; iii- Amount of magnetism in the ring. As we know, lighter the ball, it spins with greater frequency as compared to a heavy ball if they find same amount of energy to spin, therefore, the ball of charge of the electron spins with much greater frequency as compared to that with which the ball of charge of the proton spins because the electron is about 2×10^3 less massive than the proton. And consequently, μ_{se} is about 7×10^2 greater than μ_{sp}. The amount of magnetism the proton possesses too may be greater than the amount of magnetism the electron possesses and it may contribute in increasing μ_{sp}, but its contribution cannot increase μ_{sp} about 7×10^2 times.

In the structure of neutron, the electron and proton are set such that the direction of L_{sm} of the proton lies opposite to the direction of L_{sm} of the electron, and similarly the direction of L_{sc} of the proton lies opposite to the direction of L_{sc} of the electron. Since the electron and proton both possess their linear motion along the directions of their respective L_{sc}, in the neutron, they travel in directions opposite to each other. Then, it is obvious that they front on collide with each other. When they collide, since the proton is much heavier (about 2×10^3 times), obviously it shall be larger too in size than the electron, the proton is neither being pushed behind nor stops moving. It goes on moving forward in the direction of its linear motion but its velocity is of course being reduced (according to the law of conservation of momentum). The electron stops moving forward and its velocity is being reduced to zero. Then obviously it is dragged along with the proton in the direction of linear motion of the proton. After collision with the proton, since the velocity of electron is reduced to zero, the frequency of spin motion of its ball (of charge), say ω_c, starts decreasing according to expression [5] $m\mathrm{v}^2 = h\omega$ (where h is Planck's constant, $m, \mathrm{v}, and\ \omega$ are respectively the mass, linear velocity and frequency of spin motion of the particle), because, when v of a particle starts decreasing, its ω starts decreasing according to this expression. The frequency of spin motion of the ball (ω_c) of electron goes on decreasing till a situation arises when L_{sc} of the electron is reduced as much that L_{sm} of the electron starts becoming greater than its (electron) L_{sc}. And when the difference (L_{sm} - L_{sc}) is increased as much that the electron can move in the direction of its L_{sm} with velocity greater than the velocity of proton and against the attractive Coulomb force by the proton on it, it is separated from the proton and starts moving in the direction of its L_{sm}. And, in this way, the neutron decays into a proton and an electron. (When the neutron becomes stable, the separation of its electron from its proton is stopped, see section-3.3.)

After, or may be before the separation of electron from the proton, the frequency of spin motion of the charge of electron starts increasing again, and during the course of motion of electron in the direction of its L_{sm}, a situation comes when its L_{sc} starts becoming greater than its L_{sm}. When the difference (L_{sc} - L_{sm}) is increased as much that the electron can move towards it L_{sc}, it starts moving again towards it L_{sc}, i.e. towards the proton, and combines with the proton. Thus the whole process (i.e. the combination of electron with the proton, their separation, and their combination again) goes on continuously. During this process, since the whole system (i.e. electron and proton of the neutron) continues moving in the direction of motion of the proton, the neutron possesses its linear motion in the direction of linear motion of the proton. (When the electron and proton collide, how their energy and momentum etc. conserve, see section-9.2.3.)

2.1 Note

Currently it is believed that the electrons do not reside inside the nuclei. They are generated inside the nuclei at the time of β decay. This belief has been developed due to the following reasons: i- Finite size; ii- Spin angular momentum; iii- Statistics; iv- Magnetic moment; v- Principle of uncertainty; vi- Compton wave length etc. of electron. But the present model resolves all the above first five reasons (see section-3). Sixth reason is also resolved because the electrons (and other matter particles too) do not have wave nature (for detail, see reference-5).

3. EXPLANATION OF THE PROPERTIES OF NEUTRON AND OF SOME RELATED PHENOMENA/EVENTS

3.1 Mean life time (t) of neutron

The time elapsed in between when the proton and electron combine (collide) with each other and when they are separated from each other, happens to be the mean life time (t) of neutron.

3.2 Why and how t happens to be = 885.7 ± 0.8 seconds

During the course of time in between when the proton and electron combine (collide) with each other and when they are separated from each other, the following two events take place: i- The velocity of the electron is reduced to zero; ii- Consequently the frequency of spin motion of the charge of electron and hence L_{sc} starts decreasing, and when L_{sc} is reduced as much that the electron can move in the direction of its L_{sm} with velocity greater than the velocity of proton, the electron is separated from the proton (see section-2). The first event of course takes no time but the second event takes time and that happens to be = 885.7 ± 0.8 seconds [6].

3.3 Why and how neutron has stable and unstable both the states

In the free state of neutron, after time t the electron and proton are separated from each other, i.e. the neutron decays, and therefore the neutron happens to be unstable in its free state. In stable nuclei and systems, the separation of electron from the proton is stopped (why and how the separation is stopped, see sections-4, 5, and 6), consequently the neutron becomes stable. Therefore, the neutron has stable and unstable both the states.

3.4 Magnetic moment of neutron

According to existing expression $\mu_s = (q/2m)L_s$ for the spin magnetic moment (μ_s) of a spinning particle (having charge q, mass m, and spin angular momentum L_s), since the neutron has no charge, its spin magnetic moment (μ_{sn}) should be zero. But on the contrary, the neutron has spin magnetic moment. For that, it is argued that neutron is not a charge less particle but has net charge = 0. It means, neutron is constituted by two or more than two particles, each having charge and μ_s such that the resultants of their charge and of their μ_s give respectively the zero charge and μ_{sn} (= -0.00966236×10^{-24} J/T) of neutron.

Suppose if it is argued that the constituent particles of neutron have charge but do not have spin magnetic moment, and when they constitute the neutron, due to spin motion of its net charge, the neutron obtains its μ_{sn}, this argument cannot be accepted. Because: 1- When the net charge on the neutron becomes zero and it spins, the zero charge spins, and hence μ_{sn} should be zero; 2- The questions arise, how and from where does the net charge obtain spin motion and how does that (spin motion) persist? Because for persistent spin motion, the net charge must have infinite energy or some source of infinite energy, how and from where does the net charge obtain that? If it is argued that, before constituting the neutron, the constituent particles possess spin motion, then they must have their spin magnetic moments too. Because when they have charge and possess spin motion, they must have their spin magnetic moments.

The particles which constitute a neutron are a proton and an electron (see section-2). Electron and proton have charge $-e$ and $+e$, and spin magnetic moment μ_{se} and μ_{sp} respectively (see section-2), and when combining with each other they constitute a neutron, the net charge of neutron becomes = 0 and the net spin magnetic moment ($\boldsymbol{\mu_{sn}}$) = $\boldsymbol{\mu_{sp} \pm \mu_{se}}$. In the structure of neutron, since the directions of L_{sm} of electron and proton are in opposite directions (see section-2), and the directions of μ_{se} and μ_{sp} of electron and proton lie respectively in the directions of their L_{sm}, μ_{se} and μ_{sp} lie in directions opposite to each other. And hence $\mu_{sn} = \mu_{se}$ (= $-9.2847637\times10^{-24}\ J/T$) **-** μ_{sp} (= $0.01410607 \times10^{-24}$ J/T) = $-9.27065768\times10^{-24}$ J/T, and it should occur in the direction of μ_{se} because $\mu_{se} > \mu_{sp}$. The experimental value of μ_{sn} = $-0.00966236\times10^{-24}$ J/T has same sign as the theoretical (presently obtained) value of μ_{sn} has, but is much lesser (about 7×10^{2}) than the theoretical value ($-9.27065768 \times10^{-24}$ J/T). The reason is probably as follows:

The proton has same amount of charge (+e) as the electron has (-e), but μ_{sp} is about 2×10^3 times lesser than μ_{se}. The decrease of about 2×10^3 times in the value of μ_{sp} is due to having about 2×10^3 times more mass by the proton in comparison to that of the electron. Since the neutron too is about 2×10^3 times more massive than the electron, μ_{sn} is reduced by about 7×10^2 times. This conclusion cannot be overruled because, as the net charge of neutron is zero, it means, when electron and proton combine with each other, though they do not merge into a single particle but combine such that the resultant combination (neutron) becomes just like a single particle. Further, we find that μ_{sn} is a little $<\mu_{sp}$ while m_n (mass of neutron = 1.6749×10^{-27} Kg) is a little $>m_p$ (mass of proton = 1.6726×10^{-27} Kg), it confirms that due to increase in mass of the resultant system (i.e. neutron) by about 2×10^3 times, μ_{sn} is reduced by about 7×10^2 times.

3.5 While it is believed that the electrons do not reside inside the nuclei, then why and how the electrons are emitted from the nuclei during β decay

In the structure of a neutron (say N_1), after collision of its electron (say E_1) with its proton (say P_1), since the velocity of proton P_1 is decreased, hence as soon as the tendency in the electron E_1 to move along the direction of its L_{sm} is developed, the velocity of proton P_1 starts increasing again, and when the electron is separated from the proton, the rate of increase in the velocity of proton is increased and the proton tries to regain the original value (say V) it had before its collision with the electron. Hence, the distance gap, which is created in between the proton and the electron after their separation and when the electron is just to start moving again towards the proton, happens to be very short. Therefore, though the process of separation of electron from the proton and their recombination goes on continuously, but together they behave just like a single particle.

In the stable nuclei and systems (e.g. deuterons and α particles), the neutrons and protons are so arranged and bound with each other such that the continuous process of separation and recombination of electrons with protons in the structures of their respective neutrons are being stopped (for detail, see sections-4 to 6). Hence, inside the nuclei and systems, the electrons are not found in states as, e.g., protons are found. Therefore, it can be said or concluded that the electrons do not reside inside the nuclei. They reside as a part of the structure of neutrons.

In nuclei when A becomes > 200, the stabilities of neutrons start getting weak (see section-9.2.1), i.e. in the structures of neutrons, the stable combinations of their electrons with their respective protons start getting loose. Then the separation and recombination of their electrons with their protons start again And when in any neutron, the combination of its electron with its proton is broken and the electron is separated from the proton, if this electron is found in position, as shown in Fig. 2(b), with a group G (see section-7), the electron is ejected from its neutron and also from the nucleus, and thus a β decay is obtained (for detail, see section-9.2.1). The ejection of electron is caused due to the repulsive force [4] between the electron and the group G .

3.6 Why and how β particles emitted from the radioactive sources have continuous energy spectrum

When a neutron (say N_1) becomes unstable and its electron E_1, after getting separated from its proton P_1 starts moving away from the proton, the energy of the electron varies continuously and similarly when the electron starts moving again towards the proton to combine with that, then too its energy varies continuously. [The course of time t (mean life time of neutron), during which the electron remains in contact with the proton, then too the energy of the electron varies continuously due to the variation in frequency of spin motion of the charge of electron, because it varies the spin energy of the electron.] The situation, Fig. 2(b), between the electron and the group G can come at any instant during the course of time, say t' (when the electron is moving away from the proton), or during the course of time, say t" (when the electron is moving towards the proton). Therefore, the electron can be ejected at any instant during the course of time t' + t" and hence accordingly the ejected electron possesses its energy. (The emitted electron possesses that energy too, it obtains by the repulsive force.) The energy of the electron since varies continuously throughout the full course of time t'+ t", the energy of the emitted electron (i.e. β particle) too varies accordingly and hence the energy of the emitted β particle is obtained in the form of a continuous energy spectrum.

3.7 Why and how the neutron has high penetrating power

In order to explain why neutrons have high penetrating power, let us first take an example. We take two bullets (spherical/cylindrical) of same mass, size and substance, and to one bullet we give a conical shape at its front side. If these bullets are fired with the same energy on the same target from the same distance one after the other, we shall find that the depth of penetration of the bullet, having conical shape at its front side, is more as compared to the depth of penetration of the other bullet. In the structure of neutron, since the electron lies always in front of the proton during its (proton) motion (whether the electron is moving away from the proton getting separated from that or moving towards that), and the electron is much lighter than the proton (then obviously the electron shall be smaller too), the electron produces almost the same effect as the conical shape at the front of the bullet produces. Consequently the neutrons possess high penetrating power.

Further, the neutron possesses motional energy [5] M.E. {= K.E. (kinetic energy) + S.E. (spin energy [5])} = M.E. of proton + M.E. of electron, and motional momentum [5] M.M. {= L.M. (linear momentum) + S.M. (spin momentum [5])} = M.M. of proton + M.M. of electron. The M.E. and M.M. of the electron too increase the penetrating power of the neutron.

Thus the penetrating power of a neutron is increased quite a lot.

3.8 Why and how the neutron has distinguishable low and high energy ranges

In the structure of neutron, the course of time t', during which the electron moves away from the proton after separation from that, the neutron possesses M.E. = continuously increasing M.E. of proton (because, after collision, the proton immediately starts trying to regain its original velocity V, which it had before its collision with the electron, see section-3.5) + varying K.E. of electron [which varies accordingly as its difference (L_{sm} - L_{sc}) and the Coulomb attractive force acting on it due to positive charge on the proton, vary] + S.E. of the magnetic ring of electron – S.E. of the ball of charge of electron. Therefore, accordingly the effective M.E. of neutron varies and it (effective M.E. of neutron) happens to be continuously increasing. And the course of time t'', during which the electron of the neutron moves towards its (neutron) proton, the neutron possesses M.E. = increasing M.E. of proton – continuously increasing K.E. of electron [which varies accordingly as its difference (L_{sc} - L_{sm}) and the Coulomb attractive force on it vary] + S.E. of the magnetic ring of electron - S.E. of the charge of electron. Therefore, accordingly M.E. of neutron varies and it (M.E.) happens to be continuously decreasing.

The course of time t, during which the electron of the neutron remains in contact with its (neutron) proton, then too the effective M.E. of neutron varies, because, after collision of the electron with the proton, since the proton immediately starts trying to regain its original velocity V, the M.E. of proton goes on increasing. And also (after collision) since ω of the ball of charge of electron starts decreasing, which goes on decreasing till L_{sm} becomes greater than L_{sc} and the difference (L_{sm} - L_{sc}) is increased as much that the electron starts moving in the direction of it's L_{sm}, S.E. of the ball of charge of electron goes on decreasing. Therefore, M.E. of neutron varies, as the increasing M.E. of proton – the decreasing S.E. of the ball of electron varies. This variation occurs in the form of a gradual increasing order.

Thus, during the course of time t + t', M.E. of neutron goes on increasing, and during the course of time t'', it goes on decreasing.

The moment when the disintegration takes place, the neutron may be at any instant of the courses of time t + t'+ t''. Consequently, accordingly the neutron possesses its energy. If the obtained neutron is of the course of time t + t', it possesses an energy range which happens to be of increasing order, i.e. high-energy range. And if the obtained neutron is of the course of time t'', it possesses an energy range but happens to be of decreasing order, i.e. low-energy range.

3.9 Discussion

According to Quark model [3], a neutron is composed of two down quarks (d_1 and d_2), each having charge [3] –e/3 and mass [3] 4.1 to 5.8 MeV/c^2, and one up quark (u), having charge [3] +2e/3 and mass [3] 1.7 to 3.3 MeV/c^2, and thus has zero net charge. The up and down quarks in the neutron are arranged as (u d_1 d_2), Fig. [3] 3. A proton is composed of one down quark (d) and two up quarks (u_1 and u_2) and thus has +e net charge and the quarks are arranged as (u_1 d u_2), Fig. 3. This model explains the beta decay successfully, i.e., a down quark d_2 decays into a lighter up quark u_2 emitting a virtual W^- boson [3] having charge [7] -e and mass [7] 80.398 ± 0.023 GeV/c^2, and W^- boson decays into an electron (β^-) and an antineutrino, Fig. 3. But this model gives rise to numerous very serious such questions of which no explanation can be given. For example: 1- How (i.e. mechanism) does the down quark d_2 decays into the lighter up quark u_2 emitting a virtual W^- boson? If it is argued that it occurs due to weak interaction [3], then the questions arise, does the weak interaction take 885.7 ± 0.8 s? Or especially in this case does it take 885.7 ± 0.8 s? If especially in this case it takes 885.7 ± 0.8 s, then the question arises why and how? Further, does the weak interaction take place within the quark d_2 itself or between the quarks d_1 and d_2 or among the quarks u, d_1 and d_2? If it takes place between the quarks d_1 and d_2 or among the quarks u, d_1 and d_2, then what does happen to the electrostatic Coulomb interaction? Since the electrostatic Coulomb interaction is 10^{10} times stronger than the weak interaction, the role of electrostatic Coulomb interaction cannot be ignored or overruled. Then how does the weak interaction come into play?

If the weak interaction takes place within the quark d_2 itself, how, why and what does happen within the quark d_2 that it decays into a lighter up quark u_2 emitting a virtual W^- boson? Further, the assumptions, e.g.: 1. The decay of quark d_2 having charge –e/3, into a quark u_2 having charge +2e/3 emitting a virtual W^- boson; 2. Emission of a virtual W^- boson; 3. Even being a virtual particle, possession of mass by W^- boson, that too about 10^4 times more than that of the mother quark d_2; 4. Even being a virtual particle, possession of charge by W^- boson, that too –e while the mother quark d_2 has only charge −e/3; 5. Decay of virtual W^- boson, which physically does not exist, into a real electron β^-, which physically exists; are puzzling. These assumptions are unbelievable and hence cannot be accepted. How, by which mechanism and/or according to which scientific (physical/ chemical) law, do the above events take place? As the consequence of decay of a quark d_2 into a quark u_2, a real particle of mass (4.1 to 5.8 - 1.7 to 3.3) MeV/c^2 can be emitted, or, according to mass-energy equivalence principle (theory of relativity), an energy (4.1 to 5.8 - 1.7 to 3.3) MeV can be emitted, but the occurrence of the above events is not possible to believe.

What are the physical interpretations of: 1. Virtual W^- boson; 2. Possession of mass and charge by virtual W^- boson; 3. Emission of virtual W^- boson as the consequence of decay of a real quark d_2; 4. Decay of that virtual W^- boson into a real electron (β^-) etc.? As far as the author's knowledge is concerned, it is believed that there exist only matter and energy in the universe and they are inter-convertible. In which category does the virtual W^- boson lie?

Further, why and how does the decay of quark d_2 into a quark u_2 take place only in unstable nuclei, why and how not in stable nuclei/systems? Why, how and what does happen in stable nuclei/ systems such that the decay of quark d_2 stops?

Furthermore, how does the neutron obtains its spin magnetic moment (μ_{sn})? Suppose if it is argued that when the neutron spins, since its all the three quarks (one u quark and two d quarks) which have charge spin, the neutron acquires μ_{sn}, this argument cannot be accepted. Because one u quark two d quarks of a neutron give its net charge = 0, and when they (one u and two d) spin, zero charge spins and hence μ_{sn} should be zero. Secondly, how and from where do the neutrons (or quarks) obtain their spin motion and how does that persist? How and from where do they obtain infinite energy for their persistent spin motion?

4. EXPLANATION OF WHY AND HOW NATURE HAS PROVIDED US ONLY DEUTERON (*NP*) WHILE THE BOUND STATES, DI-PROTON (*PP*), DI-NEUTRON (*NN*) ARE ALSO THEORETICALLY POSSIBLE BUT DO NOT EXIST

4.1 Why and how nature has provided us deuteron (*NP*).

When the difference (L_{sm} - L_{sc}) is increased as much that the electron E_1 [of neutron N_1, Fig. 4(a)] can move in the direction of its L_{sm} with velocity greater than the velocity of proton P_1 (of neutron N_1) against the attractive Coulomb force by the proton, the electron is separated from the proton and starts moving in the direction of its L_{sm} (see section-2). If by some means, the separation of electron from the proton is stopped, the electron shall remain with the proton, i.e. the neutron shall remain stable till the electron is separated again by some means or due to some reason, as, e.g., happens when A of the nuclei becomes > 200 (see section-9.2.1). The separation of electron from the proton can be stopped if during the process of reducing L_{sc} (see section-2) but before the difference

(L_{sm} - L_{sc}) is increased as much that the electron is separated from the proton, the effect of Coulomb force of attraction on the electron by the proton and the velocity of the proton are increased as much that the electron may not be separated from that.

The effect of Coulomb force of attraction and the velocity of proton are increased if a proton P_2, moving parallel to a neutron N_1 and in the same direction in which the neutron N_1 is moving, comes in the plane of proton P_1 (of neutron N_1), adjacent and so close to P_1 that the magnetic fields around protons P_2 and P_1 start interacting [4], as shown in Fig. 4(b). Because then, due to +e charge on proton P_2, the effect of attractive Coulomb force by proton P_1 on electron E_1 (of neutron N_1) is increased, and due to interaction between the magnetic fields of protons P_1 and P_2 a binding force F is generated between the protons P_1 P_2 and they are bound together, Fig. 4(b) [for detail, see reference-4]. When they are bound together, proton P_2 increases the velocity of proton P_1 [which was earlier reduced due to its (proton P_1) collision with electron E_1, see section-2] by dragging proton P_1 along with it. The increases in the velocity of proton P_1 and in the effect of Coulomb force of attraction do not let electron E_1 to get separated from proton P_1. Consequently, electron E_1 and proton P_1 remain in contact with each other, i.e. neutron N_1 becomes stable.

Thus in this combination of a proton P_2 and a neutron N_1 (i.e. in system N_1P_2), Fig. 4(a), neutron N_1 becomes stable, and with this stable neutron, a proton P_2 is bound with a binding force F. The binding force F between the proton P_2 and neutron N_1 generates the total binding energy $(E_t)_D$ and the binding energy per nucleon $(E_b)_D$ of deuteron.

The magnetic field around proton P_2 interacting with the magnetic field around proton P_1 (of neutron N_1) creates a magnetic field around them, having direction as shown in Fig. 4(b). The outer portion of the magnetic field obtained around them (i.e. deuteron D) possesses the shape and direction as shown in Fig. 4(c). Further, in deuteron (D), since both the nucleons (P_2 and N_1) possess their linear motion v in the same direction and parallel to each other, D too possesses its linear motion v in the same direction, Fig. 4(c).

4.2 Why and how system di-proton (*PP*) does not exist in nature, and why and how system deuteron (*NP*) exists.

In the system di-proton ($P_1 P_2$), Fig. 4(d), proton P_1 is not bound in a neutron (i.e. P_1 is not like proton P_1 of neutron N_1) but it happens to be free as proton P_2 is. Hence, in system $P_1 P_2$, there takes place interaction between two free protons P_2 and P_1. The interaction between the magnetic fields of protons P_2 and P_1 takes place in the same manner, Fig. 4(b), and a binding force F is generated between protons P_2 and P_1, but this force F does not happen to be as strong as it happens in the system $N_1 P_2$. The binding force F consists two components F_1 and F_2, i.e. $\boldsymbol{F = F_1 \pm F_2}$ (see reference-4), where component F_1 is generated due to interaction between the magnetic fields of protons P_2 and P_1, and it happens to be attractive. And component F_2 is the Coulomb force generated due to interaction between the charges on the interacting protons P_2 and P_1. In the case of system $P_1 P_2$, F_2 happens to be repulsive because the charges on protons P_2 and P_1 are similar. Therefore, the force F happens to be $= F_1 - F_2 = F_{P_1 P_2}$.

Force $F_{P_1 P_2}$ probably happens to be not sufficiently strong consequently system $P_1 P_2$ does not persist and very shortly the protons P_2 and P_1 are separated from each other. And hence the system $P_1 P_2$ does not exist in nature. [In system $P_1 P_2$, if a neutron N is added, the resultant system becomes stable (see section-5.3) and it's E_b is increased to $> 2 \times (E_b)_D$ (see section-5.4)]

In the case of system N_1P_2, Fig. 4(a and b), due to charge –e on electron E_1 (of neutron N_1), the effect of charge +e of proton P_1 is reduced quite a lot (but not to zero, the net charge of neutron N_1 is of course reduced to zero). Consequently, the repulsive component F_2 is reduced very much, say to F_2'. Therefore, the force F between N_1P_2, i.e. $F_{N_1P_2}$ becomes $= F_1 - F_2'$, and it happens to be $> F_{P_1P_2}$. Force $F_{N_1P_2}$ probably happens to be sufficiently strong, consequently the protons P_2 and P_1 (of neutron N_1) of system N_1P_2 are not being separated from each other and system N_1P_2 persists (i.e. becomes stable). And hence system NP (deuteron) exists in nature.

4.3 Why and how the system di-neutron (*NN*) does not exist in nature

In the system di-neutron (N_1N_2), Fig. 4(e), since both the protons P_1 and P_2 are of neutrons N_1 and N_2 respectively, none is happened to be free (as proton P_2 happens to be free in system N_1P_2), there occurs no means to increase the velocities of protons P_1 and P_2 so that the electrons E_1 and E_2 respectively may not be separated from the protons P_1 and P_2. Therefore, after the mean life time (t) of neutrons N_1 and N_2, the electrons E_1 and E_2 are separated from their respective protons P_1 and P_2. Then the protons P_1 and P_2 are left behind, i.e. the situation becomes exactly like the system P_1P_2. And hence the interaction takes place between protons P_1 and P_2, and the binding force F , generated due to their interaction, happens to be $= F_1 - F_2 = F_{P_1P_2}$.

Since the force $F_{P_1P_2}$ happens to be not sufficiently strong (see section-4.2), very shortly the protons P_2 and P_1 of the system are separated from each other and hence system N_1N_2 does not persist. Consequently the system NN does not exist in nature. [In system N_1N_2 , if a proton P is added, the resultant system becomes stable (see section-5.1) and it's E_b is increased to $> 2\times(E_b)_D$ (see section-5.2).]

If both the neutrons N_1 and N_2 do not decay simultaneously but decay one by one, e.g. N_2 decays first and afterwards N_1, then as soon as N_2 decays, proton P_2 (of neutron N_2) becomes almost free like proton P_2 of system N_1P_2 and it (proton P_2) increases the effect of attractive Coulomb force of proton P_1 on electron E_1 (of neutron N_1) and the velocity of proton P_1 (of neutron N_1) by dragging proton P_1 along with it. Due to these increases, electron E_1 (of neutron N_1) is not separated from proton P_1, and neutron N_1 becomes stable. And system N_1N_2 is converted into system N_1P_2.

4.4 Discussion

No explanation is found why and how nature has provided us only deuteron (NP), while the bound states of two-nucleon systems, di-proton (PP), di-neutron (NN) too are theoretically possible but do not exist in nature. If we try to explain these on the basis of the current strong short range nuclear interaction (which is assumed generated according to Yukawa's meson field theory [8]) and Coulomb interaction, we succeed to explain only why and how nature has provided us only NP, but fail to explain why and how PP and NN do not exist in nature. For non-existence of system PP, for time being it can be assumed that the Coulomb repulsive interaction between PP reduces the strength of the current strong short range nuclear interaction between them and consequently the strong short range nuclear interaction fails to keep PP bound together (though practically it is not possible because the Coulomb repulsive interaction cannot reduce the about 100 times stronger short range nuclear interaction so much). But in the case of system NN, where is no possibility of the Coulomb repulsive interaction to come into play between NN, system NN must exist. While on the contrary, it too does not exist.

5. EXPLANATION OF WHY AND HOW DUE TO ADDITION OF ONE PROTON (*P*) AND ONE NEUTRON (*N*) IN THE SYSTEMS *NN* AND *PP* RESPECTIVELY, THE RESULTANT SYSTEMS, i.e. THE NUCLEI OF H^3 AND He^3 BECOME STABLE AND THEIR E_b

BECOME > 2×$(E_b)_D$, WHY AND HOW $(E_b)_{H^3}$ > $(E_b)_{He^3}$, WHY AND HOW H^3 IS RADIOACTIVE AND DECAYS INTO He^3 THROUGH β DECAY

5.1 Why and how due to addition of one *P* in the system *NN*, the resultant system, i.e. nucleus of H^3 becomes stable

When a proton P is added in the system N_1N_2 and all the three nucleons are arranged in the same plane, very close and adjacent to each other, as shown in Fig. 5(a), and they are having their linear motion v in the same direction and parallel to each other, the resultant system i.e. the nucleus of H^3 becomes stable. Because then, due to interaction between the magnetic fields of protons P , P_1 (of neutron N_1) and P_2 (of neutron N_2), all the three nucleons are bound together in the form of a group (see reference-4), say T_1. And further, since the linear velocity of proton P is happened to be > the linear velocities of protons P_1 and P_2 [because the linear velocities of protons P_1 and P_2 were reduced due to their collisions with their respective electrons E_1 (of neutron N_1) and E_2 (of neutron N_2), see section-2], the protons P_1 and P_2 are being dragged along with proton P. Consequently, the linear velocities protons P_1 and P_2 are increased while that of proton P is decreased and ultimately they all acquire the same velocity v. And due to +e charge on proton P, the effects of attractive Coulomb force by the protons P_1 and P_2 on the electrons E_1 and E_2 respectively are increased. So, due to increase in the velocities of protons P_1 and P_2, and in the effects of attractive Coulomb force, the electrons E_1 and E_2 are not being separated from their respective protons P_1 and P_2. And thus the neutrons N_1 and N_2 become stable.

When all the three nucleons are bound together in the form of a group T_1 and the neutrons N_1 and N_2 become stable, the whole system becomes stable.

Due to interaction between the magnetic fields of protons P , P_1 and P_2, a magnetic field is created around them, Fig. 5(c). The outer portion of the magnetic field obtained around them (i.e. group T_1) possesses the shape and direction as shown in Fig. 5(g). Further, in group T_1, since all the three nucleons P , N_1 and N_2 possess their linear motion v in the same direction and parallel to each other, group T_1 too possesses its linear motion v in the same direction.

5.2 Why and how E_b of the resultant system (nucleus of H^3) becomes > $2\times(E_b)_D$

In the nucleus of H^3, when the neutrons N_1 and N_2 become stable, two deuterons D_1 (having nucleons P and N_1) and D_2 (having nucleons P and N_2) are created, Fig. 5(b), where proton P is common in both the deuterons D_1 and D_2. These two deuterons D_1 and D_2 are bound together by the binding force between N_1 and N_2 at their one ends, and at their other ends bound together due to having common P between them. Due to having common P between them, the binding generated between the deuterons D_1 and D_2 happens to be stronger than the binding generated between them due to interaction between N_1 and N_2. [In order to understand it more clearly, let us take an example. We consider two families A and B. Family A has two women (sisters), each having one son and family B has one woman having two sons. In family A, since the two women are sisters and two boys are cousins, the two women are bound with each other and similarly two boys are bound with each other. But in family B, since the mother is common between the two boys, binding among the three members happens to be stronger in comparison to binding among the four members in family A]

Therefore, the binding energy per nucleon (E_b) for the nucleus of H^3, i.e. $(E_b)_{H^3}$ is obtained as follows:

$$(E_b)_{H^3} = [E_t\,(\textit{i.e. total binding energy})\ \textit{of the nucleus of}\ H^3]/3$$

$$= [2\times(E_b)_{D_1} + 2\times(E_b)_{D_2} + 2\times(E_b \textit{ generated due to the binding force } F_{N_1N_2}) + 2\times(E_b \textit{ generated due to common } P \textit{ between the two deuterons})]/3$$

$$= [4(E_b)_D]/3 + [2\times(E_b \textit{ generated due to the binding force } F_{N_1N_2}) + 2\times(E_b \textit{ generated due to common } P \textit{ between the two deuterons})]/3$$

because $(E_b)_{D_1} = (E_b)_{D_2} = (E_b)_D$.

The above expression can be expressed as follows too:

$$(E_b)_{H^3} = 2(E_b)_D - 2(E_b)_D/3 + [2\times(E_b \textit{ generated due to the binding force } F_{N_1N_2}) + 2\times(E_b \textit{ generated due to common } P \textit{ between the two deuterons})]/3 \ldots\ldots\ldots \quad (5.1)$$

$$> 2\times(E_b)_D \ldots\ldots\ldots \quad (5.2)$$

because E_b generated due to the binding force $F_{N_1N_2} > (E_b)_D$ [see section-5.3], and E_b generated due to common P between the two deuterons $> E_b$ generated due to the binding force $F_{N_1N_2}$ and hence [2(E_b generated due to the binding force $F_{N_1N_2}$) + 2(E_b generated due to common P between the two deuterons)]/3 happens to be > 4 $(E_b)_D$/3.

5.3 Why and how due to addition of one *N* in the system *PP*, the resultant system, i.e. nucleus of *He*^{3} becomes stable

When a neutron N is added in the system P_1P_2 and all the three nucleons are arranged in the same plane, very close and adjacent to each other, as shown in Fig. 5(d), and they are having their linear motion in the same direction and parallel to each other, the resultant system i.e. the nucleus of He^3 becomes stable. Because then, due to interaction between the magnetic fields of protons P_1, P_2 and P (of neutron N), all the three nucleons are bound together in the form of a group (see reference-4), say T_2. And further, since the linear velocities of protons P_1 and P_2 are happened to be >

the linear velocity of proton P, proton P is being dragged along with the protons P_1 and P_2. Consequently, the linear velocities of protons P_1 and P_2 are increased while that of proton P is decreased and ultimately they all acquire the same velocity v. And due to +e charges on protons P_1 and P_2, the effect of attractive Coulomb force by proton P on electron E is increased. So, due to increase in the velocity of proton P and in the effect of attractive Coulomb force by the protons P_1 and P_2 on electron E, electron E is not being separated from proton P. And thus neutron N becomes stable.

When all the three nucleons are bound together in the form of a group T_2 and the neutron N becomes stable, the whole system becomes stable.

Due to interaction between the magnetic fields of protons P, P_1 and P_2, a magnetic field is created around them, Fig. 5(f). The outer portion of the magnetic field obtained around them (i.e. group T_2) possesses the shape and direction as shown in Fig. 5(g). Further, in group T_2, since all the three nucleons N, P_1 and P_2 possess their linear motion v in the same direction and parallel to each other, group T_2 too possesses its linear motion v in the same direction.

5.4 Why and how E_b of the resultant system (nucleus of He^3) becomes > $2\times(E_b)_D$

In the nucleus of He^3, Fig. 5(d), neutron N is made stable by two protons P_1 and P_2 exactly in the same manner as two neutrons N_1 and N_2 are made stable by a single proton P in the nucleus of H^3. When neutron N becomes stable, two deuterons D_1 (having nucleons N and P_1) and D_2 (having nucleons N and P_2) are created, Fig. 5(e), where neutron N is common in both the deuterons D_1 and D_2. These two deuterons D_1 and D_2 are bound together by the binding force between P_1 and P_2 at their one ends, and at their other ends bound together due to having common N between them. Due to having common N between them, the binding generated between the deuterons D_1 and D_2 happens to be stronger than the binding generated between them due to interaction between P_1 and P_2.

Therefore, E_b for the nucleus of He^3, i.e. $(E_b)_{He^3}$ is obtained as follows:

$$(E_b)_{He^3} = [E_t \textit{ of the nucleus of } He^3]/3$$

$$= [2\times(E_b)_{D_1} + 2\times(E_b)_{D_2} + 2\times(E_b \textit{ generated due to the binding force } F_{P_1P_2}) + 2\times(E_b \textit{ generated due to common } N \textit{ between the two deuterons})]/3$$

$$= 4(E_b)_D/3 + [2(E_b \textit{ generated due to the binding force } F_{P_1P_2}) + 2(E_b \textit{ generated due to common } N \textit{ between the two deuterons})]/3$$

$$= 2(E_b)_D - 2(E_b)_D/3 + [2(E_b \textit{ generated due to the binding force } F_{P_1P_2}) + 2(E_b \textit{ generated due to common } N \textit{ between the two deuterons})]/3 \quad \ldots\ldots\ldots\ldots\ldots \quad (5.3)$$

$$> 2\times(E_b)_D \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5.4)$$

because, though E_b generated due to the binding force $F_{P_1P_2} < (E_b)_D$ [see section-4.2], but, since E_b generated due to common N between the two deuterons $> (E_b)_D$, 2(E_b generated due to the binding force $F_{P_1P_2}$ + E_b generated due to common N between the two deuterons)/3 may happen to be $\geq$ or $<$ 4 $(E_b)_D$/3 but can never be $>$ 2 $(E_b)_D$/3.

5.5 Why and how $(E_b)_{H^3}$ > $(E_b)_{He^3}$

If we compare the expressions (5.1) and (5.3), we find that, in expression (5.1), E_b generated due to the binding force $F_{N_1N_2} > (E_b)_D$ [see below], while in expression (5.3), E_b generated due to the binding force $F_{P_1P_2} < (E_b)_D$ [see section-4.2]. Therefore, $(E_b)_{H^3}$ {= 2.8273 MeV [9]}> $(E_b)_{He^3}$ {= 2.5627 MeV [9]}.

How E_b generated due to the binding force $F_{N_1N_2} > (E_b)_D$, is as follows:

When the neutrons N_1 and N_2 become stable, due to charge –e on each electron E_1 and E_2, the effects of +e charge on the protons P_1 and P_2, Fig. 5(a), are reduced quite a lot, and due to that, the component F_2 of the binding force $F(= F_1 - F_2)$ between the neutrons N_1 N_2 too is reduced accordingly, say to F_2". Presently, since the effects of +e charge on both the protons P_1 and P_2 are reduced, the resultant component F_2" becomes $< F_2$' (see section-4.2), and hence the binding force F between N_1, N_2, i.e. $F_{N_1N_2}$ ($= F_1 - F_2$"), becomes $> F_{PN_1}$ ($= F_1 - F_2$') and F_{PN_2} (because F_{PN_1} = F_{PN_2}). Therefore, E_b generated due to the binding force $F_{N_1N_2} > (E_b)_D$.

5.6 Despite $(E_b)_{H^3} > (E_b)_{He^3}$, why and how H^3 is radioactive and decays into He^3 through β decay

In the nucleus of H^3, Fig. 5(a), since a single proton P dragging two protons P_1 (of neutron N_1) and P_2 (of neutron N_2) increases their velocity, and the charge +e of a single proton P increases the effects of attractive Coulomb force of two protons P_1 and P_2 on their respective electrons E_1 and E_2, proton P somehow succeeds only to keep protons P_1 and P_2 just in contacts with their respective electrons E_1 and E_2. Consequently, the neutrons N_1 and N_2 in the nucleus of H^3 are happened to be just stable (loosely stable).

Since the neutrons N_1 and N_2 in the nucleus of H^3 are happened to be just stable, these can decay if by some external means their stability is loosened a little bit more (how their stability is loosened and they decay, see section-9.2.1). Further, since it is very rarely possible that both the neutrons N_1 and N_2 decay simultaneously, they decay one by one. But as soon as one neutron, e.g. N_1 decays, proton P_1 (of neutron N_1) becomes like proton P, and then they (P_1 and P) together increase the velocity of proton P_2 (of neutron N_2) and the effect of attractive Coulomb force of it on the electron E_2 (of neutron N_2). Consequently the stability of neutron N_2 is increased and that does not decay and the nucleus of H^3 is converted (decayed) into the nucleus of He^3 [10].

5.7 An important Conclusion

The decay of H^3 into He^3 through β decay, despite $(E_b)_{H^3} > (E_b)_{He^3}$, gives an important conclusion that the strength of stability of a nucleus does not depend only upon its E_b but also upon the strength of stability of its neutrons.

The half-lives of isotope Li^4 (=9.1×10^{-23} s [11]) and of the synthesized isotope H^4 (=1.39×10^{-22} s [10]) confirm the above conclusion. The three-protons (P_1, P_2, P_3) of isotope Li^4 make its one-neutron (N), Fig. 5(h and i), very strongly stable but three interacting forces ($F_{P_1P_2}$, $F_{P_2P_3}$, $F_{P_1P_3}$) make the binding among its three protons and hence among its four nucleons very weak consequently its half-life is reduced to 9.1×10^{-23} s and emitting a proton it decays into He^3 [9]. And in isotope H^4, its one-proton (P) fails to make its three-neutrons (N_1, N_2, N_3), Fig. 5(j and k), stable consequently even having very strong binding among its all the four nucleons due to the interacting forces ($F_{N_1N_2}$, $F_{N_2N_3}$, $F_{N_1N_3}$), isotope H^4 does not exist in nature. The half-life of the synthesized isotope H^4 too happens to be very short =1.39×10^{-22} s and emitting a neutron, it decays into H^3 [10].

6. EXPLANATION OF HOW TWO-NEUTRONS AND TWO-PROTONS ARE ARRANGED IN A α PARTICLE SUCH THAT IT PERSISTS AND BEHAVES LIKE A PARTICLE, HOW BEAMS OF α PARTICLES ARE OBTAINED DESPITE HAVING REPULSIVE COULOMB FORCE BETWEEN THEM, AND WHY AND HOW IT'S E_b IS INCREASED TO > $6\times(E_b)_D$ INSTEAD OF INCREASING TO $2\times(E_b)_D$

6.1 How two-neutrons and two-protons are arranged in a α particle such that it persists and behaves like a particle, and how beams of α particles are obtained despite having repulsive Coulomb force between them

In the structure of α particle, two neutrons N_1, N_2 and two protons P_1, P_2 are arranged as shown in Fig. 6(a), and all the four nucleons possess their linear motion v in the same direction and parallel to each other. In this structure, we see: i- The pair of one-proton and one-neutron $P_1\ N_1$ behaves like deuteron D_1, $N_1\ P_2$ behaves like deuteron D_2, $P_2\ N_2$ behaves like deuteron D_3, and $N_2\ P_1$ behaves like deuteron D_4, Fig. 6(b); ii- Every combination of two-protons and one-neutron, $P_1\ N_1\ P_2$ and $P_2\ N_2\ P_1$ behaves like a group T_2, Fig. 6(c); and iii- Every combination of two-neutrons and one-proton, $N_1\ P_2\ N_2$ and $N_2\ P_1\ N_1$ behaves like a group T_1, Fig. 6(d). As in the case of nucleus of He^3 (i.e. group T_2), its neutron N happens to be strongly stable, similarly in the combinations- $P_1\ N_1\ P_2$ and $P_2\ N_2\ P_1$ of α particle, Fig. 6(c), neutrons N_1 and N_2 are strongly stable. And, as in the case of nucleus of H^3 (i.e. group T_1), since its all the three nucleons are strongly bound with each other, similarly in every combination- $N_1\ P_2\ N_2$ and $N_2\ P_1\ N_1$ of α particle, Fig. 6(d), all the three nucleons are strongly bound with each other. And thus, in a α particle, it's both the neutrons are strongly stable and all the four nucleons are strongly bound with each other. Consequently, a α particle, despite being a combination of four nucleons, behaves like a single particle. Further, in α particle, since all its four nucleons possess their linear motion v in the same direction, α particle too possesses its linear motion v in the same direction.

In α particle, due to interaction between magnetic fields of all its four nucleons, a magnetic field is created around them, Fig. 6(e). The outer portion of the magnetic field obtained around them (i.e. α particle or group G) possesses the shape and direction as shown in Fig. 6(f). The shape and direction of magnetic field obtained around a α particle, Fig. 6(f), are happened to be similar as obtained around an electron, Fig. 1(b). Consequently, α particles behave just like electrons, protons etc., and their (α particles) beams can be obtained despite having repulsive Coulomb force between them, similarly as electron beams are obtained despite having repulsive Coulomb force between them (see reference-4).

6.2 Why and how E_b of α particle is increased to > 6×$(E_b)_D$ instead of increasing to 2×$(E_b)_D$

In the structure of α particle, Fig. 6(b): i- Two deuterons D_1 and D_2 are bound together at their one ends by the binding force between P_1 and P_2, and at their other ends due to having common N_1 between them; ii- Two deuterons D_2 and D_3 are bound together at their one ends by the binding force between N_1 and N_2, and at their other ends due to having common P_2 between them; iii- Two deuterons D_3 and D_4 are bound together at their one ends by the binding force between P_1 and P_2, and at their other ends due to having common N_2 between them; iv- Two deuterons D_4 and D_1 are bound together at their one ends by the binding force between N_1 and N_2, and at their other ends due to having common P_1 between them.

Therefore, E_b for α particle, i.e. $(E_b)_\alpha$ is obtained as follows:

$$(E_b)_\alpha = [E_t\,(total\ binding\ energy)\ of\ \alpha\ particle]/4$$

$$= [2\times(E_b)_{D_1} + 2\times(E_b)_{D_2} + 2\times(E_b)_{D_3} + 2\times(E_b)_{D_4} + 2\times(E_b\ generated\ due\ to\ the$$

$$binding\ force\ F_{P_1P_2} + E_b\ generated\ due\ to\ common\ N_1\ between\ the\ two\ deuterons$$

$$D_1D_2)_{considering\ interaction\ between\ D_1D_2} + 2\times(E_b\ generated\ due\ the\ binding\ force\ F_{N_1N_2} + E_b$$

$$generated\ due\ to\ common\ P_2\ between\ the\ two\ deuterons\ D_2D_3)_{considering\ interaction\ between\ D_2D_3}$$

$$+ 2\times(E_b\ generated\ due\ to\ the\ binding\ force\ F_{P_1P_2} + E_b\ generated\ due\ to\ common\ N_2$$

$$between\,the\,two\,deuterons\,D_3D_4)_{considering\,\text{int}\,eraction\,between\,D_3D_4} + 2\times(E_b\ generated\ due\ to$$

$$the\,binding\ force\,F_{N_1N_2} + E_b\ generated\ due\,to\,common\,P_1\,between\,the\,two\,deuterons$$

$$D_4D_1)_{considering\,\text{int}\,eraction\,between\,D_4D_1}]/4$$

$$= [8\times(E_b)_D + 4\times(E_b\ generated\ due\,to\,the\,binding\ force\,F_{N_1N_2}) + 4\times(E_b\ generated\ due$$

$$to\,the\,binding\ force\,F_{P_1P_2}) + 8\times(E_b\ generated\ due\,to\,common\,nucleon\,between\,the$$

$$two\,deuterons)]/4 \quad \ldots\ldots \quad (6.1)$$

because $(E_b)_{D_1} = (E_b)_{D_2} = (E_b)_{D_3} = (E_b)_{D_4} = (E_b)_D$ and (E_b generated due to common P_1 between the deuterons D_1D_4) = (E_b generated due to common N_1 between the deuterons D_1D_2) = (E_b generated due to common P_2 between the deuterons D_2D_3) = (E_b generated due to common N_2 between the deuterons D_3D_4) = (E_b generated due to common nucleon between the two deuterons). Further, since in eqn. (6.1), E_b generated due to the binding force $F_{N_1N_2} > (E_b)_D$ [see section-5.5], E_b generated due to the binding force $F_{P_1P_2} < (E_b)_D$ [see section-4.2], and E_b generated due to common nucleon between the two deuterons $> E_b$ generated due to the binding force $F_{N_1N_2}$ [see section-5.2], eqn. (6.1) reduces to

$$(E_b)_\alpha > 6\times(E_b)_D \quad \ldots\ldots \quad (6.2)$$

7. EXPLANATION OF HOW NUCLEONS ARE ARRANGED IN NUCLEI HAVING A = INTEGER MULTIPLE OF 4 SUCH THAT THEY (NUCLEI) ARE MOST STRONGLY STABLE, HOW THEIR E_b INCREASES AS THEIR A INCREASES IN MULTIPLE OF 4, AND HOW E_b OF Be^8 IS REDUCED TO < E_b OF He^4 WHILE A OF Be^8 = 2×A OF He^4

In nuclei with mass number (A) integer multiple of 4, such as $He^4, Be^8, C^{12}, O^{16}, Ne^{20}$ etc., the nucleons are arranged forming groups (G), each group having 4 nucleons, two protons and two neutrons. In every group, two protons and two neutrons are arranged exactly in the same manner as arranged in a α particle, Fig. 6(a), and the directions of linear motion of all the four nucleons, lie in the same direction and parallel to each other. And hence, every group G in every nucleus possesses its linear motion in the direction of linear motions of its nucleons.

7.1 How nucleons are arranged in a nucleus having A = 4 (He^4), and determination of its E_b

In the nucleus of He^4, there occurs only one group G, and two neutrons and two protons are arranged in that group in the same manner as they are arranged in a α particle. And hence, the nucleus of He^4 has same E_b as a α particle has.

7.2 How nucleons are arranged in a nucleus having A = 8 (Be^8), and determination of its E_b

In the nucleus of Be^8, there occur two groups G_1, G_2 (each having 4 nucleons) and they are arranged, as shown in Fig. 7(a). Group G_1 possesses its linear motion along +X direction and group G_2 along –X direction. Due to having linear motions by the groups G_1 and G_2 towards each other, they try to come close to each other, but due to having +2e charges on them, the repulsive Coulomb force between them does not allow them to do so. When the forces on them due to their linear motions and due to Coulomb repulsion become equal to each other, they stop coming close to each other after setting a certain distance, say g, between them.

Due to having linear motions by the groups G_1 and G_2 along +X and –X directions, the magnetic fields around them occur in planes perpendicular to X axis (i.e. in Y Z plane) and parallel to each other. And the directions of magnetic fields around them lie in directions opposite to each other, as shown by round arrows in their centers, Fig. 7(a).

Since the magnetic fields around the groups G_1 and G_2 occur in planes parallel to each other, they (magnetic fields) do not interact with each other and hence no binding force is generated between the groups G_1 and G_2. Therefore, the binding energy per nucleon (E_b) for the nucleus of Be^8, i.e. $(E_b)_{Be}$, is obtained as follows:

$$(E_b)_{Be} = [\, E_t \text{ (i.e. total binding energy) of group } G_1 + E_t \text{ of group } G_2 \,] /8$$

$$= E_t \text{ of group } G /4$$

because E_t of all the groups $G_1, G_2, G_3, \ldots$.. are equal and say $= E_t$ of group G. Therefore,

$$(E_b)_{Be} = (E_b)_{He} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7.1)$$

where $(E_b)_{He}$ is the binding energy per nucleon (E_b) for the nucleus of He^4.

7.2.1 Why and how E_b of nuclei of Be^8 < E_b of nuclei of He^4

To overcome the repulsive Coulomb force between the groups G_1 and G_2, since they (groups G_1 and G_2) loose their some energy, their binding energies [E_t of group G_1 and E_t of group G_2] are reduced, and hence $(E_b)_{Be}$ is also reduced. Consequently, $(E_b)_{Be}$ happens to be a little $< (E_b)_{He}$.

7.3 How nucleons are arranged in a nucleus having A = 12 (C^{12}) and its E_b is increased to > E_b of He^4

In the nucleus of C^{12}, there occur three groups G_1, G_2, G_3 and they are arranged as shown in Fig. 7(b), where the groups G_1, G_2 are arranged exactly as they are arranged in the nucleus of Be^8. The additional group G_3 possesses its linear motion along –Y direction and hence the magnetic field around it occurs in X Z plane (perpendicular to Y axis). The magnetic field around group G_3 possesses direction as shown by round arrow in its centre, Fig. 7(b).

The portion of the magnetic field occurring around group G_3 and lying towards our left hand side, Fig. 7(b), interacts with the magnetic field occurring around group G_1. And the portion of the magnetic field occurring around group G_3 and lying towards our right hand side interacts with the magnetic field occurring around group G_2. Because of having directions by the magnetic fields around the groups G_1, G_2, G_3, as shown by round arrows in their centers, Fig. 7(b), the interactions between the magnetic fields of the groups G_1, G_3, and between the magnetic fields of the groups G_2, G_3, are happened to be attractive (for verification of its truth, see section-7.9). Consequently, the left side of group G_3 is bound with group G_1, and similarly the right side of group G_3 is bound with group G_2. And thus, the groups G_1 and G_2 are bound with each other through group G_3.

When, in the nucleus of C^{12}, all the three groups are bound together, all the 12 nucleons are also bound and hence $(E_b)_C$ is obtained as follows:

$(E_b)_C$ = [(E_t of group $G_1 + E_t$ of group $G_2 +$ E_t of group G_3) + B.E. (binding energy) generated due to interaction between the magnetic fields around groups $G_1 \& G_3$ + B.E. generated due to interaction between the magnetic fields around groups $G_2 \& G_3$] /12

= [$3\times E_t$ of group G + B.E. generated due to interaction between the magnetic fields around (groups $G_1 \& G_3$ + groups $G_2 \& G_3$)]/12

= E_t of group G /4 + [B.E. generated due to interaction between the magnetic fields around (groups $G_1 \& G_3$ + groups $G_2 \& G_3$)]/12

= $(E_b)_{He}$ + [B.E. generated due to interaction between the magnetic fields around (groups $G_1 \& G_3$ + groups $G_2 \& G_3$)]/12 .... (7.2)

> $(E_b)_{He}$ .... (7.3)

7.4 How nucleons are arranged in a nucleus having A = 16 (O^{16}) and its E_b is increased to > E_b of C^{12}

In the nucleus of O^{16}, there occur four groups G_1, G_2, G_3, G_4 and they are arranged as shown in Fig. 7(c). The groups G_1, G_2, G_3 are arranged exactly as they are arranged in the nucleus of C^{12}, and hence the directions of their linear velocities, planes and directions of their magnetic fields too are arranged exactly as these are arranged in the nucleus of C^{12}. The groups G_1, G_2, G_3 are bound together due to interactions between their magnetic fields exactly as they are bound together in the nucleus of C^{12} due to interactions between their magnetic fields.

The additional group G_4 possesses its linear motion along +Y direction, and the magnetic field around it occurs in X Z plane and possesses direction as shown by round arrow in the center of group G_4, Fig. 7(c). The portion of the magnetic field around group G_4, occurring on our left hand side, interacts with the magnetic field occurring around group G_1. And similarly the portion of the magnetic field around group G_4, occurring on our right hand side, interacts with the magnetic fields occurring around group G_2. Consequently, the left and right sides of group G_4 are bound respectively with group G_1 and group G_2. Thus, all the four groups G_1, G_2, G_3, G_4 and hence all the 16 nucleons are bound together (for verification of its truth, see section-7.9).

Therefore, $(E_b)_O$ is obtained as follows:

$(E_b)_O =$ [(E_t of group $G_1 +$ E_t of group $G_2 +$ E_t of group $G_3 + E_t$ of group G_4) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & $G_3 +$ groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)] /16

= E_t of group G /4 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & $G_3 +$ groups G_2 & $G_3 +$ groups G_1 & $G_4 +$ groups G_2 & G_4)]/16

= $(E_b)_{He}$ + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)]/16 ….. (7.4)

= [$(E_b)_{He}$ + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)}/12] – [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)]/48 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_4 + groups G_2 & G_4)] /16

= $(E_b)_C$ – [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)]/48 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_4 + groups G_2 & G_4)] /16... (7.5)

Because from expression (7.2), $(E_b)_{He}$ + (B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/12 = $(E_b)_C$. Therefore,

$(E_b)_O > (E_b)_C$ ……………………………………………………………………… (7.6)

because in expression (7.5), B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_4 + groups G_2 & G_4)/16 can never be ≤B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/48

7.5 How nucleons are arranged in a nucleus having A = 20 (Ne^{20}) and its E_b is increased to > E_b of O^{16}

In the nucleus of Ne^{20}, there occur five groups G_1, G_2, G_3, G_4, G_5 and they are arranged as shown in Fig. 7(d), where the groups G_1, G_2, G_3, G_4 are arranged exactly as they are arranged in the nucleus of O^{16}. The additional group G_5 possesses its linear motion along +Z direction and the magnetic field around it occurs in X Y plane and possesses direction as shown by round arrow in the center of group G_5, Fig. 7(d). The portions of the magnetic field around group G_5, occurring on our left hand side, on our right hand side, on our front side, and on opposite to our front side interact with the magnetic fields occurring around group G_1, group G_2, group G_3, and group G_4 respectively. Consequently, the sides of the group G_5, lying towards our left hand side, our right hand side, our front side, and opposite to our front side are bound respectively with group G_1, group G_2, group G_3, and group G_4. Thus, all the five groups G_1, G_2, G_3, G_4, G_5 and hence all the 20 nucleons are bound together.

Therefore, $(E_b)_{Ne}$ is obtained as follows:

$(E_b)_{Ne}$ = [(E_t of group G_1 + E_t of group G_2 + E_t of group G_3 + E_t of group G_4 + E_t of group G_5)

+ {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)} + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)}] /20

= E_t of group G /4 + [{B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)} + { B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)}]/20

= $(E_b)_{He}$ + [{B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)} + { B.E.

generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)}]/20 …………………… (7.7)

= [$(E_b)_{He}$ + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)}/16] – [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)]/80 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)]/20

= $(E_b)_O$ – [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)]/80 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)]/20 …………………… (7.8)

Because from expression (7.4), [$(E_b)_{He}$ + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)}/16] = $(E_b)_O$.

Therefore,

$(E_b)_{Ne} > (E_b)_O$ ……………………………………………………………… (7.9)

because in expression (7.8), [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)]/20 can never be $\leq$ [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)]/80

7.6 How nucleons are arranged in a nucleus having A = 24 (Mg^{24}) and its E_b is increased to > E_b of Ne^{20}

In the nucleus of Mg^{24}, there occur six groups $G_1, G_2, G_3, G_4, G_5, G_6$ and they are arranged as shown in Fig. 7(e),where the groups G_1, G_2, G_3, G_4, G_5 are arranged exactly as they are arranged in the nucleus of Ne^{20}.The additional group G_6 possesses its linear motion along -Z direction and the magnetic field around it occurs in X Y plane and possesses direction as shown by round arrow in the center of group G_6, Fig. 7(e). The portions of the magnetic field around group G_6, occurring on our left hand side, on our right hand side, on our front side, and on opposite to our front side interact with the magnetic fields occurring around group G_1, group G_2, group G_3, and group G_4 respectively. Consequently, the sides of the group G_6, lying towards our left hand side, our right hand side, our front side, and opposite to our front side are bound respectively with group G_1, group G_2, group G_3, and group G_4. In this way, all the six groups $G_1, G_2, G_3, G_4, G_5, G_6$ and hence all the 24 nucleons are bound together (for verification of its truth, see section-7.9).

Therefore, $(E_b)_{Mg}$ is obtained as follows:

$(E_b)_{Mg}$ = [(E_t of group G_1 + E_t of group G_2 + E_t of group G_3 + E_t of group G_4 + E_t of group G_5 + E_t of group G_6) + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)} + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)} + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_6 + groups G_2 & G_6 + groups G_3 & G_6 + groups G_4 & G_6)}] /24

= E_t of group G /4 + [{B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4)} + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)} + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_6 + groups G_2 & G_6 + groups G_3 & G_6 + groups G_4 & G_6)}]/24

= [$(E_b)_{He}$ + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)}/20] – [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4) + B.E. generated due to interaction between the magnetic fields of (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)]/120 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_6 + groups G_2 & G_6 + groups G_3 & G_6 + groups G_4 & G_6)]/24

= $(E_b)_{Ne}$ - [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)]/120 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_6 + groups G_2 & G_6 + groups G_3 & G_6 + groups G_4 & G_6)]/24 ………………………………….. (7.10)

because from expression (7.7), $(E_b)_{He}$ + {B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)}/20 = $(E_b)_{Ne}$. Therefore,

$(E_b)_{Mg} > (E_b)_{Ne}$ ……………………………………………………………………. (7.11)

because in expression (7.10), [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_6 + groups G_2 & G_6 + groups G_3 & G_6 + groups G_4 & G_6)]/24 can never be ≤ [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3 + groups G_1 & G_4 + groups G_2 & G_4) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_5 + groups G_2 & G_5 + groups G_3 & G_5 + groups G_4 & G_5)]/120

7.7 How nucleons are arranged in nuclei having A = 28, 32, 36, 40 etc. and their E_b increases

In the nucleus having 28 nucleons, the nucleons are grouped in 7 groups $G_1, G_2, G_3, G_4, G_5, G_6, G_7$. Six groups $G_1, G_2, G_3, G_4, G_5, G_6$ are arranged as shown in Fig. 7(e) and seventh group G_7 is arranged behind any of the six groups $G_1, G_2, G_3, G_4, G_5, G_6$. Let us assume group G_7 is arranged behind group G_1. Then the direction of linear motion of group G_7 lies in the same direction in which the direction of linear motion of group G_1 lies, and the plane of magnetic field around group G_7 is parallel to the plane of magnetic field around group G_1 and the of direction of magnetic field around group G_7 lies in the same directions in which the direction of magnetic field around group G_1 lies. If group G_7 is arranged behind group G_2, the direction of linear motion of group G_7 lies in the same direction in which the direction of linear motion of group G_2 lies, and the plane of magnetic field around group G_7 is parallel to the plane of magnetic field around group G_2 and the direction of magnetic field around group G_7 lies in the same directions in which the direction of magnetic field around group G_2 lies. Due to having repulsive Coulomb force between the groups G_1 and G_7 (when group G_7 is arranged behind group G_1), group G_7 is not set behind group G_1 touching that, but is set at some distance apart from that. Since group G_7 is set behind group G_1, outer portions (or can say, weaker portions) of the magnetic fields occurring around the groups G_3, G_4, G_5, G_6, which are left free from the interaction with the magnetic field occurring around group G_1, are available to interact with the magnetic field occurring around group G_7. Consequently, group G_7 is bound with the groups G_3, G_4, G_5, G_6, but with lesser binding force in comparison to that with which group G_1 is bound. And hence, E_b of the nucleus (having A = 28) is increased but with reduced magnitude. Similarly as A of the nucleus increases by integer multiple of 4, the number of G type groups goes on increasing one by one and they go on setting behind the groups G_2, G_3, G_4, G_5, G_6 and so on, and accordingly E_b of the nucleus goes on increasing. It goes on till A becomes = 48. When A increases beyond 48 (by integer multiple of 4), the groups start setting behind the groups G_7, G_8, G_9 and so on till A becomes = 72. But now (i.e. when A increases beyond 48), the increase in E_b is reduced further and near A = 62, it (increase in E_b) becomes minimum. So, near A = 62, E_b, after attaining its maximum value, starts decreasing as A increases (why and how it starts decreasing, see section-9).

7.8 Why and how nuclei having A = integer multiple of 4, are most strongly stable

As have been described above in sections-7.1 to 7.7, in all the nuclei of He^4, Be^8, C^{12}, O^{16}, Ne^{20} etc., the nucleons are arranged forming groups G, which (groups G) are very strongly stable.

And secondly, when G groups (two, three, four and so on) interact, due to interaction between their magnetic fields, a strong binding is generated between them, while if other groups D, T_1, T_2 interact between themselves or with G (see section-8), due to interaction between their magnetic fields, loose bindings are generated between them. Consequently, nuclei having A = integer multiple of 4, are most strongly stable.

7.9 Experimental verification of the truth of binding of groups G_1, G_2, G_3 etc. with each other due to interaction between their magnetic fields

Let us take three groups H_1, H_2 and H_3, each group having four electric current carrying very small pieces of rods. Let us arrange all these three groups as the groups G_1, G_2, G_3 are arranged in Fig. 7(b). The directions of flow of current through the rods of groups H_1, H_2, H_3 are respectively along –X, +X, +Y directions. Then the electrons shall flow through the rods of groups H_1, H_2, H_3 respectively along +X, -X, -Y directions, i.e. the electrons shall have their linear motion through the rods of groups H_1, H_2, H_3 along the same directions, along which the nucleons of groups G_1, G_2, G_3 have directions of their linear motions. Now if a current is allowed to flow through the rods of all the three groups H_1, H_2, H_3, all the three groups are bound together. Similarly the three groups G_1, G_2, G_3 are also bound together in the nucleus of C^{12} (see section-7.3).

If we take one more similar group H_4, having the direction of flow of current through its rods along –Y, and arrange it along with the groups H_1, H_2, H_3 as group G_4 is arranged along with the groups G_1, G_2, G_3, Fig. 7(c), all the four groups H_1, H_2, H_3, H_4 are bound together as soon as a current is allowed to flow through the rods of all the four groups. Similarly the four groups G_1, G_2, G_3, G_4 are also bound together in the nucleus of O^{16} (see section-7.4).

If we take one more similar group H_5, having the direction of flow of current through its rods along -Z, and arrange it along with the groups H_1, H_2, H_3, H_4 as group G_5 is arranged along with the groups G_1, G_2, G_3, G_4, Fig. 7(d), all the five groups H_1, H_2, H_3, H_4, H_5 are bound together as soon as a current is allowed to flow through the rods of all the five groups. Similarly the five groups G_1, G_2, G_3, G_4, G_5 are also bound together in the nucleus of Ne^{20} (see section-7.5).

If we take one more similar group H_6, having the direction of flow of current through its rods along + Z, and arrange it along with the groups H_1, H_2, H_3, H_4, H_5 as group G_6 is arranged along with the groups G_1, G_2, G_3, G_4, G_5, Fig. 7(e), all the six groups $H_1, H_2, H_3, H_4, H_5, H_6$ are bound together as soon as a current is allowed to flow through the rods of all the six groups. Similarly the six groups $G_1, G_2, G_3, G_4, G_5, G_6$ are also bound together in the nucleus of Mg^{24} (see section-7.6).

8. HOW NUCLEONS ARE ARRANGED IN NUCLEI HAVING A ≠ INTEGER MULTIPLE OF 4 (e.g. Li^6, Li^7, B^{11} and N^{14}) SUCH THAT THESE ARE NOT STRONGLY STABLE, HOW E_b OF Li^6 AND Li^7 ARE REDUCED TO < E_b OF He^4, E_b OF B^{11} TO < E_b OF Be^8, AND E_b OF N^{14} TO < E_b OF C^{12} WHILE E_b OF NUCLEI INCREASES AS THEIR A INCREASES

8.1 How nucleons are arranged in the nuclei of Li^6, Li^7 such that their (Li^6, Li^7) E_b increase as their A increases but are reduced to < E_b of He^4

In the nucleus of Li^6, 6 nucleons are arranged in two groups, two-neutrons and two-protons in group G and one-neutron and one-proton in group D, and the groups G and D are arranged as shown in Fig. 8(a). Group G possesses its linear motion along +X direction, and the magnetic field around it occurs in YZ plane and in direction as shown by round arrow in its middle, Fig. 8(a). And group D possesses its linear motion along -X direction, and the magnetic field around it occurs in YZ plane and in direction as shown by round arrow in its centre, Fig. 8(a).

The groups G and D, because of having their linear motions along +X and –X directions respectively, move towards each other, but due to Coulomb repulsive force between them (because of having charges +2e and +e by the groups G and D respectively), they stop moving forward towards each other after a certain distance, say d', between them.

Since the magnetic fields around the groups G and D occur in planes parallel to each other, they (magnetic fields) do not interact with each other and hence no binding force is generated between the groups G and D. Therefore, the binding energy per nucleon (E_b) for the nucleus of Li^6, i.e. $(E_b)_{Li^6}$, is obtained as follows:

$$(E_b)_{Li^6} = [\, E_t \text{ (i.e. total binding energy) of group } G + E_t \text{ of group } D\,]/6$$

$$= [4\times(E_b)_{He} + 2\times(E_b)_D]/6 \qquad \text{where } (E_b)_D \text{ is } E_b \text{ of deuteron}$$

$$\approx [4\times(E_b)_{He} + 2\times(E_b)_{He}/6]/6 \qquad \text{because } (E_b)_D \approx [(E_b)_{He}]/6$$

$$\approx 0.72\times(E_b)_{He} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \qquad (8.1)$$

But against the repulsive Coulomb force between the groups G and D, since the groups G and D loose their some energy, E_t of groups G and D are reduced, and hence $(E_b)_{Li^6}$ is also reduced.

In the nucleus of Li^7, 7 nucleons are arranged in two groups, two-neutrons and two-protons in group G and two-neutrons and one-proton in group T_1, and the groups G and T_1 are arranged, as shown in Fig. 8(b). Group G possesses its linear motion along +X direction, and the magnetic field around it occurs in Y Z plane and in direction shown by round arrow in its centre, Fig. 8(b). And group T_1 possesses its linear motion along -X direction, and the magnetic field around it occurs in Y Z plane and in direction shown by round arrow in its centre, Fig. 8(b).

The groups G and T_1, because of having linear motion along +X and –X directions respectively, move towards each other, but due to Coulomb repulsive force between them (because of having charges +2e and +e by the groups G and T_1 respectively), they stop moving forward towards each other after a certain distance, say d", between them.

Since the magnetic fields around the groups G and T_1 occur in planes parallel to each other, they (magnetic fields) do not interact with each other and hence no binding force is generated between the groups G and T_1. Therefore, the binding energy per nucleon (E_b) for the nucleus of Li^7, i.e. $(E_b)_{Li^7}$, is obtained as follows:

$$(E_b)_{Li^7} = [\, E_t \text{ of group } G + E_t \text{ of group } T_1] \,/7$$

$$= [4\times(E_b)_{He} + 3\times(E_b)_{T_1}] \,/7 \qquad \text{where } (E_b)_{T_1} \text{ is } E_b \text{ of group } T_1$$

$$= [4\times(E_b)_{He} + 3\times 2.55\,(E_b)_D] \,/7 \qquad \text{because } (E_b)_{T_1} = 2.55\,(E_b)_D \text{ [7]}$$

$$\approx [4\times(E_b)_{He} + 3\times 2.55\,(E_b)_{He}/6] \,/7 \qquad \text{because } (E_b)_D \approx [(E_b)_{He}]/6$$

$$\approx 0.75\,(E_b)_{He} \quad \dots\dots\dots \quad (8.2)$$

But against the repulsive Coulomb force between the groups G and T_1, since the groups G and T_1 loose their some energy, E_t of groups G and T_1 are reduced, and hence $(E_b)_{Li^7}$ is also reduced.

From the expressions (8.1) and (8.2) we see, $(E_b)_{Li^7} > (E_b)_{Li^6}$, i.e. as A increases (i.e. from 6 to 7), E_b of nuclei increases, but $(E_b)_{Li^7}$ and $(E_b)_{Li^6}$ both are $< (E_b)_{He}$.

8.2 How nucleons are arranged in the nucleus of B^{11} such that its E_b is reduced to < E_b of Be^8 though A of B^{11} > A of Be^8

In the nucleus of B^{11}, 11 nucleons are arranged in three groups, two-neutrons and two-protons in group G_1, two-neutrons and two-protons in group G_2, and two-neutrons and on-proton in group T_1, and the groups G_1, G_2 and T_1 are arranged as shown in Fig. 8(c). The groups G_1 and G_2 possess their linear motions along +X and –X directions respectively, and the magnetic fields around them occur in Y Z plane and in directions opposite to each other, shown by round arrows in their centers in Fig. 8(c). Group T_1 possesses its linear motion along -Y direction, and the magnetic field around it occurs in X Z plane and in direction shown by round arrow in its centre, Fig. 8(c).

Since the magnetic field around group T_1 happens to be of triangular shape [see Fig. 5(g)], a very little portion of the magnetic field around group T_1, lying towards our left hand side, interacts with the magnetic field around group G_1. And similarly, a very little portion of the magnetic field around group T_1, lying towards our right hand side, interacts with the magnetic field around group G_2. Consequently, the left and right sides of group T_1 are loosely bound with the groups G_1 and G_2 respectively, and hence the groups G_1 and G_2 are loosely bound with each other through the group T_1 (for confirmation of its truth, see section-8.4).

Therefore, E_b for the nucleus of B^{11}, i.e. $(E_b)_{B^{11}}$, is obtained as follows:

$(E_b)_{B^{11}} =$ [(E_t of group $G_1 + E_t$ of group $G_2 + E_t$ of group T_1) + B.E. generated due to interaction between the magnetic fields of (groups G_1 & T_1 + groups G_2 & T_1)]/11

= [(2× E_t of groups $G + E_t$ of group T_1) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & T_1 + groups G_2 & T_1)] /11

= [2×{4× $(E_b)_{He}$} + 3× $(E_b)_{T_1}$ + B.E. generated due to interaction between the magnetic fields around (groups G_1 & T_1 + groups G_2 & T_1)]/11

≈ [8× $(E_b)_{He}$ + 3×2.55 $(E_b)_{He}$/6+ B.E. generated due to interaction between the magnetic fields around (groups G_1 & T_1 + groups G_2 & T_1)]/11

≈ 18.55 $(E_b)_{He}$/22 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & T_1 + groups G_2 & T_1)]/11

$\approx$ $(E_b)_{He}$- $\{3.45(E_b)_{He}\}/22$ + [B.E. generated due to interaction between the magnetic fields around (groups $G_1 \& T_1$+ groups $G_2 \& T_1$)]/11 .... (8.3)

$<$ $(E_b)_{Be}$ .... (8.4)

Because in expression (8.3), the value of B.E. generated due to interaction between the magnetic fields around (groups $G_1 \& T_1$+ groups $G_2 \& T_1$)/11 happens to be very small, and hence can never be $\geq \{3.45(E_b)_{He}\}/22$.

8.3 How nucleons are arranged in the nucleus of N^{14} such that its E_b reduced to < E_b of C^{12} though A of N^{14} > A of C^{12}

In the nucleus of N^{14}, 14 nucleons are arranged in four groups, two-neutrons and two-protons in each group G_1, G_2, G_3, and one-neutron and one-proton in group D, and all the four groups G_1, G_2, G_3, D are arranged as shown in Fig. 8(d). The groups G_1, G_2 and G_3 possess their linear motions along +X, –X and -Y directions respectively, and the magnetic fields around the groups G_1, G_2 occur in Y Z plane and around group G_3 occurs in X Z plane. And the directions of magnetic fields around them occur as have been shown by round arrows in their centers in Fig. 8(d). Group D possesses its linear motion along +Y direction, and the magnetic field around it occurs in X Z plane. The direction of magnetic field around it occurs as has been shown by round arrow in its centers in Fig. 8(d). Since the magnetic field around group D happens to be of rectangular shape, Fig. 4(c), a very little portion of the magnetic field around group D, lying towards our left hand side, interacts with the magnetic field around group G_1. And similarly, a very little portion of the magnetic field around group D, lying towards our right hand side, interacts with the magnetic field around group G_2. Hence, the groups G_1 and G_2 are bound with each other through the group D, but their binding happens to be loose (for its confirmation, see section-8.4).

The binding energy per nucleon for the nucleus of N^{14} , i.e. $(E_b)_{N^{14}}$, is obtained as follows:

$(E_b)_{N^{14}}$ = [(E_t of group $G_1 + E_t$ of group $G_2 + E_t$ of group $G_3 +$ E_t of group D) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + groups G_2 & D)] /14

= [3× E_t of groups $G + E_t$ of group $D +$ B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + groups G_2 & D)]/14

= [3×{4× $(E_b)_{He}$ } + 2× $(E_b)_D$ + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3) + B.E. generated due to interaction between the magnetic fields of (groups G_1 & D + groups G_2 & D)]/14

≈ [12× $(E_b)_{He}$ + 2× $(E_b)_{He}$/6 + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + groups G_2 & D)]/14

≈ 37 $(E_b)_{He}$/42 + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3) + B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + groups G_2 & D)]/14

$\approx$ [$(E_b)_{He}$ + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/12] – [5$(E_b)_{He}$/42 + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/84] + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + groups G_2 & D]/14

$\approx$ $(E_b)_C$ – [5$(E_b)_{He}$/42 + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/84] + [B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + groups G_2 & D]/14 ………………………………………………………………… (8.5)

Because from expression (7.2), $(E_b)_{He}$ + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/12 = $(E_b)_C$. Therefore,

$$(E_b)_{N^{14}} < (E_b)_C \quad \text{……………………………………………………………...} \quad (8.6)$$

because in expression (8.5), the value of B.E. generated due to interaction between the magnetic fields around (groups G_1 & D + of groups G_2 & D)/14 happens to be very small and hence can never be $\geq$ [5$(E_b)_{He}$/42 + B.E. generated due to interaction between the magnetic fields around (groups G_1 & G_3 + groups G_2 & G_3)/84].

8.4 Experimental confirmation of the truth of loose binding when two or more *G* groups are bound together through a *D* or *T₁* or *T₂* group

We take two groups H_1, H_2 and one group J (having three current carrying very small pieces of rods) and arrange group J along with the groups H_1, H_2 as group G_3 is arranged along with the groups G_1, G_2, Fig. 7(b). If the flow of current through the rods of groups H_1, H_2 and J are respectively along –X, +X +Y directions, the two groups H_1, H_2 are bound together through group J as soon as a current is allowed to flow through the rods of all the three groups. But their binding happens to be loose as compared to if in place of group J , a group H_3 is placed. Similarly the groups G_1 and G_2 too are loosely bound with each other through the group T_1 (section-8.2).

We take three groups H_1, H_2, H_3 and one group K (having two current carrying very small pieces of rods) and arrange group K along with the groups H_1, H_2, H_3 as group G_4 is arranged along with the groups G_1, G_2, G_3, Fig. 7(c). If the flow of current through the rods of groups H_1, H_2, H_3 and K are respectively along –X, +X, +Y, -Y directions, all the four groups H_1, H_2, H_3 and K are bound together as soon as a current is allowed to flow through the rods of all the four groups. But their binding happens to be loose as compared to if in place of group K , a group H_4 is placed. Similarly the groups G_1, G_2, G_3 and D too are loosely bound with each other (section-8.3).

9. EXPLANATION OF WHY AND HOW E_b OF NUCLEI, AFTER BECOMING MAXIMUM NEAR A = 62, GRADUALLY STARTS DECREASING AS A INCREASES, AND FOR A > 200, NUCLEI BECOME RADIOACTIVE AND THE α , β , γ AND ν ARE EMITTED FROM THEM, AND THE γ AND ν OBTAIN PARTICLE LIKE EXISTANCE AND SO HIGH ENERGY

9.1 Why and how E_b of nuclei, after becoming maximum near A = 62 [9], gradually starts decreasing as A increases.

In the nucleus, nucleons do not reside independently (except hydrogen, where one proton resides independently in the nucleus) but reside in the form of different types of groups G (having two-neutrons and two-protons, see section-7), T_1 (having one-proton and two-neutrons, see section-5), T_2 (having two-protons and one-neutron, see section-5), and D (having one-proton and one-neutron, see section-4). The nucleons are arranged in the form of above types of groups in nuclei of different mass number (A), as have been described, e.g., in sections-4, 5, 6, 7, 8.

In a nucleus, when the nucleons are arranged in the form of above types of groups, among them, there act three types of forces: 1- The force which they possess due to having their linear velocity; 2- The force due to interaction between their magnetic fields which (magnetic fields) occur around them; 3- The Coulomb repulsive force due to having positive charge on them (+e on groups D and T_1, +2e on groups T_2 and G). The first two forces try to bring the groups close to each other while the third Coulomb repulsive force tries to oppose the first two forces. The first force remains always constant and does not depend on A, but the second and third forces go on increasing as A increases, because as A increases, the closeness among the groups increases. Therefore, E_b of the nucleus depends upon the resultant of second and third forces. Up to A = 24, the rate of increase in the magnitude of second force happens to be quite fast (see sections-7.1 to 7.6 and also section-8). The rate of increase in the magnitude of third force happens to be comparatively negligible. Consequently E_b incases quite fast. Beyond A = 24 as A increases, the rate of increase in the magnitude of second force is reduced (see section-7.7). The rate of increase in the magnitude of third force also probably now starts becoming gradually significant. Consequently, increase in E_b becomes slow. And beyond A = 48 as A increases, the rate of increase in the magnitude of second force is reduced further, and the rate of increase in the magnitude of third force probably now becomes significant. Consequently, near A = 62, after attaining its maximum value E_b starts gradually decreasing.

9.2 Why and how the nuclei become radioactive when A > 200 and the α , β , γ and ν are emitted from them

9.2.1 Why and how the nuclei become radioactive when A > 200 and the α and β are emitted

Beyond A is nearly = 62 as A increases, the closeness among the groups is probably increased as much that the third force gradually starts becoming more and more significant. Consequently E_b gradually starts decreasing and goes on decreasing continuously. When A > 200, E_b is probably reduced as much that the bindings of the outer most groups with the joint group (say G_R) of the rest of all the other inner groups, start getting gradually loose.

Beyond Z is nearly = 45 as A increases, in nuclei, the percentage of N starts increasing in comparison to Z , and in heavy nuclei, it becomes nearly 50% higher than Z . It means, beyond Z is nearly = 45 as A increases, in nuclei, the percentage of groups T_1 starts increasing in comparison to the other groups (because in a group T_1, there occur two neutrons and one proton, see section-5.1 and 5.2). Therefore, in heavy nuclei, among the outer groups, the percentage of groups T_1 happens to be higher in comparison to other groups.

In a heavy nucleus, suppose a group $(T_1)_m$ is set behind a group G_n . In heavy nuclei, since all the groups become very close to each other, due to having +e more charge on group G_n , group G_n becomes able to influence the electrons of the neutrons of group $(T_1)_m$. Since the neutrons in groups T_1 are happened to be loosely stable (see section-5.6), the influence of +e more charge of group G_n , loosens the stability of neutrons of group $(T_1)_m$ even more. Now if the binding of group $(T_1)_m$ with group G_R is broken [which becomes possible in heavy nuclei, because in heavy nuclei, their E_b is probably reduced as much that the bindings of the outer most groups with group G_R start getting gradually loose], the electrons of the neutrons of group $(T_1)_m$ may be separated from their respective protons. When they are separated, both the electrons are probably not separated simultaneously but one electron is separated at a time. When one electron, say E_1 (of neutron N_1) is separated from proton P_1, Fig. 5(a), proton P_1 becomes like proton P, and hence they together increase the velocity of proton P_2 (of neutron N_2). Consequently, the stability of neutron N_2 is increased. Then group $(T_1)_m$ is converted into group T_2 (see section-5.6).

After separation of electron E_1 from neutron N_1 of $(T_1)_m$, the conversion process of group $(T_1)_m$ into group T_2 is not completed immediately. It takes time and may be completed at any instant during the course of time t'+ t" (see section-3.6) of the travel of electron E_1. If even during the time t'+ t", the conversion process of group $(T_1)_m$ into group T_2 is not being completed, electron E_1 collides again with proton P_1 (of neutron N_1). Then at any instant during time t of neutron N_1, electron E_2 (of neutron N_2) may be separated from proton P_2 (of neutron N_2), and with electron E_2 same process may be repeated. In this way, this process goes on. During the course of time t'+ t" of electron E_1 or of E_2 if that is found in position, as shown in Fig. 2(b), with a group G, that electron is ejected from the nucleus as the consequence of repulsive force on that by group G, or electron and group G both are ejected from the nucleus. The ejection of electron, or of electron and group G both, depends upon whether group G is free or bound with group G_R. If group G is free, then electron and group G both may be ejected simultaneously, i.e. α and β both the decays may take place. And if group G is bound, then only the electron is ejected, i.e. only β decay takes place. The energy of the ejected electron depends upon, at which instant of the course of time t'+ t" the electron is found in position as shown in Fig. 2(b) with a group G and is ejected, because the ejected electron possesses energy what it had at the instant when it was ejected (for detail, see section-3.6). During the course of time t of electron E_1 or of E_2 if that is found in position, as shown in Fig. 2(b), with a group G, group G is only ejected, i.e. α decay takes place. (How two types of β decay, i.e. β^+ and β^- decays take place, it shall be submitted for publication later on but shortly because it needs a lot of discussion. That is presently not possible because that is beyond the scope of the present paper.)

The groups T_1, T_2, and D are not ejected (emitted) from the nuclei because: 1- In nuclei having A > 200, since the percentage of N becomes nearly 50% higher than Z, the possibility of occurrence of groups T_2 and D among the outer groups is probably reduced to zero, and hence their ejection (emission) from the nuclei is also reduced to zero; 2- Since the nucleons in the groups T_1, T_2, and D are not so strongly bound as are bound in group G, the groups T_1, T_2, and D do not behave like particles, and also, the magnetic fields around the groups T_1, T_2 are happened to be of triangular shape, Fig. 5(g), and around group D that happens to be of rectangular shape, Fig. 4(c), hence when any one of these groups is found in situation with an electron of neutron of group T_1, as group G is found, Fig. 2(b), due to interaction between their (electron and group T_1/group T_2/group D) magnetic fields, the repulsive force generated between them probably happens to be weak and not sufficient to eject group T_1/group T_2/group D from the nuclei.

The groups G, T_1, T_2, D cannot be ejected (emitted) from the nuclei due to interaction between their magnetic fields, because for their ejection, it is essential that when their magnetic fields interact, the magnetic fields must be in same plane and opposite in directions, as shown in Fig. 2(b) where the magnetic fields around the electron and group G are lying in the same plane but opposite in directions. The magnetic fields around two groups (e.g. groups G and T_1, groups G and T_2, groups T_1 and T_2 etc.) can come in situation as shown in Fig. 2(b) only if they (two groups) are moving parallel to each other but opposite in directions, and it can be possible only if they are free to move in nuclei. While in nuclei, all the groups are bound in a group and are not free to move freely.

When A of nuclei becomes > 200, the bindings of the outer groups become loose only; they do not become free to move freely.

9.2.2 Why and how the γ and neutrino ν are emitted and they obtain their particle like existence

In Compton's scattering experiment, a γ photon collides with an electron. It can be possible only if the γ photon too physically exists similarly as the electron exists. The charge of electron provides physical existence to it, and hence, to provide physical existence to γ particle, there too must be some thing. That thing is a bundle of radiant energy. This bundle of radiant energy provides a particle like physical existence to γ photon. The infrared, visible, or ultraviolet photons emitted from the orbiting (or can say, atomic) electrons are the bundles of radiant energy. They are emitted from the orbiting electrons as the consequence of their expansion and sudden compression (for detail, see reference-5). In nuclei, the electrons do not travel in orbits, but in neutron structure when they collide with their respective protons (e.g. electron E_1 of neutron N_1 with its proton P_1), they suffer sudden jerk, that produces almost the same effect the compression produces and with much strength. Consequently, a bundle of radiant energy is emitted out from each of the colliding electrons. The bundles of radiant energy thus obtained are the γ photons we observe emitting during the nuclear decays. (The compression of electrons cannot be ruled out or denied because if a proton can shrink [12, 13], the electron too can shrink.)

When the electrons collide with their respective protons, since the protons too suffer jerk, a bundle of energy is emitted from each of the colliding protons. Those bundles are the neutrinos.

Currently it is believed that, when a nucleus emits α or (and) β particle(s), the daughter nucleus is usually left in an excited state. It can then move to a lower energy state by emitting a γ photon, in much the same way that an atomic electron can jump to a lower energy state by emitting infrared, visible, or ultraviolet photons. But by such mechanism, neither the infrared, visible, ultraviolet photons are emitted (see reference-5) nor can the γ photons be emitted. Because, by such mechanism, the difference of energy between the two states can never be emitted in the form of a bundle having a particle like physical existence and such a high penetrating power. Further, the emission of a γ photon from a nucleus typically requires only 10^{-12} seconds [14], and is thus nearly instantaneous. The emission of a γ photon as the consequence of collision of an electron with a proton is instantaneous.

9.2.3 Why and how γ and ν obtain so high energy and momentum

After collision with proton P_1 when the velocity of electron E_1 is reduced to zero, a bundle of radiant energy is emitted from the electron E_1 in the form of a γ particle and the difference, "M.E. of electron E_1 before its collision - M.E. of electron E_1 after its collision – radiant energy contained in the γ photon", is imparted to the γ particle as its M.E. in order to conserve the M.E. of electron E_1. The difference, "M.M. of electron E_1 before its collision - M.M. of electron E_1 after its collision", is imparted to the γ photon as its M.M. in order to conserve the M.M. of electron E_1. And the difference, "L_s (resultant spin angular momentum = $\boldsymbol{L_{sc}} \pm \boldsymbol{L_{sm}}$) of electron E_1 before its collision - L_s of electron E_1 after its collision", is imparted to the γ photon as it's L_s in order to conserve L_s of electron E_1 (for detail, see reference-5).

Similarly, after collision with electron E_1 when the velocity of proton P_1 is reduced, a bundle of energy is emitted from proton P_1 in the form of a neutrino (ν) and the difference, "M.E. of proton P_1 before its collision - M.E. of proton P_1 after its collision – energy contained in ν", is imparted to ν as its M.E. in order to conserve the M.E. of proton P_1. The difference, "M.M. of proton P_1 before its collision - M.M. of proton P_1 after its collision", is imparted to ν as its M.M. in order to conserve the M.M. of proton P_1. And the difference, "L_s (resultant spin angular momentum $= \boldsymbol{L_{sc}} \pm \boldsymbol{L_{sm}}$) of proton P_1 before its collision - L_s of proton P_1 after its collision", is imparted to ν as it's L_s in order to conserve L_s of proton P_1.

After the collision, e.g. of electron E_1 with proton P_1, since the velocity of electron E_1 is reduced to zero, the difference in its M.E. and in M.M. between its two states (before collision and after collision) are happened to be quite large. Consequently, the M.E. and M.M. of the emitted γ photon from electron E_1 too are happened to be quite large. Due to very large M.M. of γ photons, they possess very high penetrating power. (How M.M. of photons provides penetrating power to them, see reference-5).

The difference in M.E. and in M.M. between the two states, e.g. of proton P_1 too are happened to be quite large, and consequently the M.E. and M.M. of the emitted ν from proton P_1 are happened to be quite large.

9.2.4 Question mark over the existence of antineutrino

Anti means opposite or reverse, and if the neutrino is a bundle of energy, the antineutrino must be a bundle of anti energy, or can say of negative energy, as, e.g., an anti electron (i.e. positron) is assumed to be a bundle of +e. But the anti energy does not exist in nature and hence the antineutrino cannot be a bundle of anti energy.

Currently it is assumed that due to having anti spin states, the antineutrino obtains the anti state of neutrino. But this assumption gives rise to several questions, e.g., how and from where do the neutrino and antineutrino obtain their spin motions, spin states, and why and how are their spin states anti to each other? If it is argued that they obtain their spin motions, anti spin states from the neutron, the questions arise, how and from where does the neutron obtain its spin motion, how does that persist, and how and from where does the neutron obtain energy for their persistent spin motion? Following the current concepts, since no answer to these questions can be given, the spin motion of neutron and hence of neutrino and antineutrino, and their anti spin states cannot be assumed. So, the current assumption is ruled out.

Then how is antineutrino anti to neutrino? And further, how is it produced? These questions raise question mark over the existence of antineutrino.

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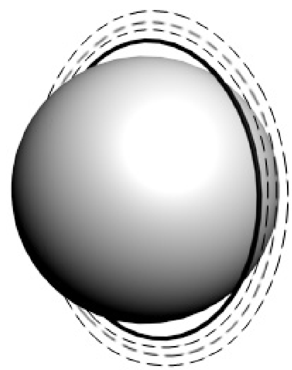
[10] http://en.wikipedia.org/wiki/Isotopes_of_hydrogen

[11] http://en.wikipedia.org/wiki/Isotopes_of_lithium

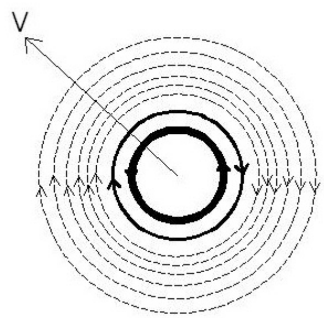
[12] http://en.wikipedia.org/wiki/Atomic_nucleus

[13] Geoff Brumfiel (July 7, 2010). "The proton shrinks in a size." Nature. Doi:10.1038/news. 2010.337

[14] http://en.wikipedia.org/wiki/Gamma_ray

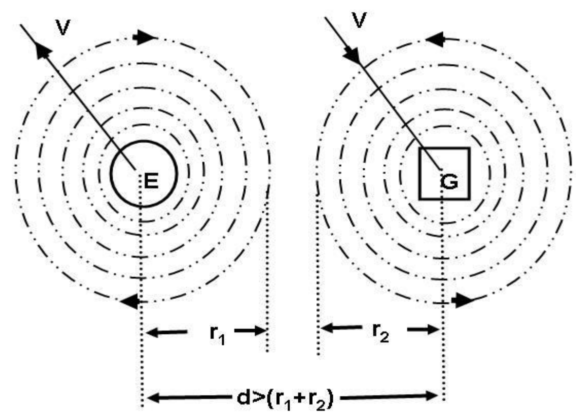


(a)



(b)

Fig. 1: (a) Spherical ball, dark solid line circle and concentric broken line circles respectively represent the charge, magnetism and magnetic field of electron. **(b)** Cross sectional view of electron where, in order to introduce arrow marks with the ball of charge to show the direction of its spin motion, the ball of charge has been shown by a dark thick solid line circle.



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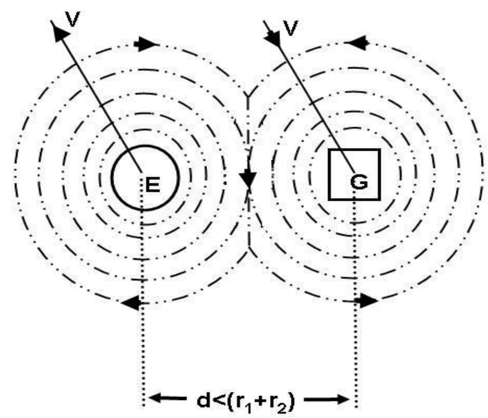


(b)

Fig. 2: **(a)**Transverse cross sectional view of motion of an electron E and a group G at the instant when they are in the same plane and at distance *d* apart while moving parallel to each other with same velocity v but opposite in directions. **(b)** Transverse cross sectional view of interaction between their magnetic fields when the distance d between them is $<(r_1+r_2)$.

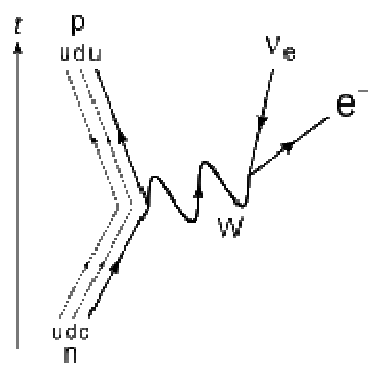


Fig. 3: The Feynman diagram for β decay of a neutron into a proton, electron, and antineutrino via an intermediate W^- boson.

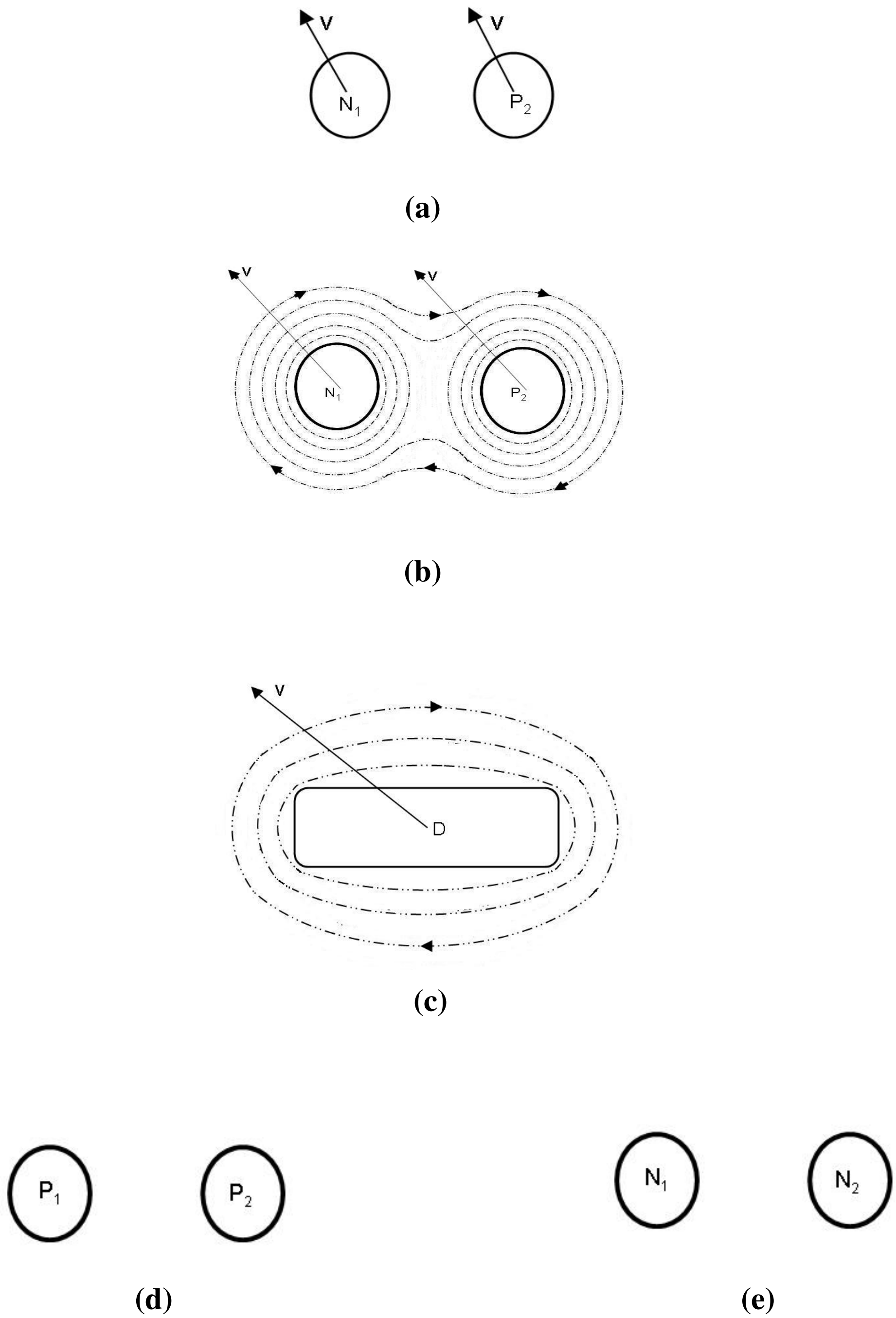
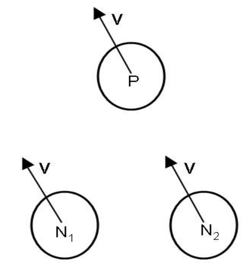
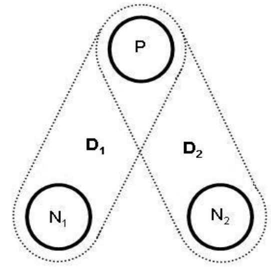


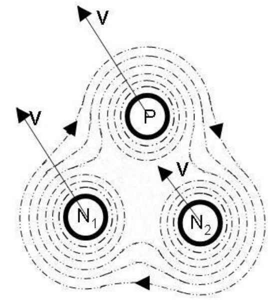
Fig. 4: In the structure of a deuteron: **(a)** arrangement of one-neutron and one-proton each having linear velocity v; **(b)** interaction between the magnetic fields of nucleons; **(c)** shape of the outer portion of the magnetic field obtained around the deuteron. **(d)** In the structure of di-proton, arrangement of two-protons. **(e)** In the structure of di-neutron, arrangement of two-neutrons.


V
P
V
N$_1$
V
N$_2$

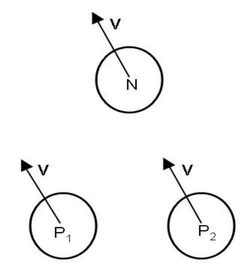
(a)


P
D$_1$
D$_2$
N$_1$
N$_2$

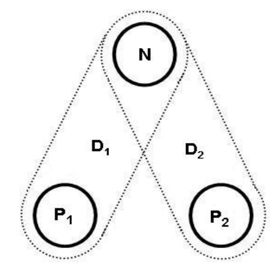
(b)


V
P
V
V
N$_1$
N$_2$

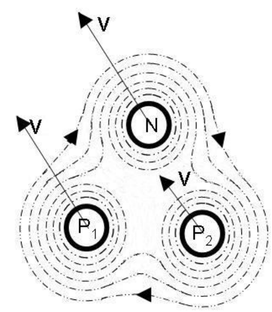
(c)


V
N
V
P$_1$
V
P$_2$

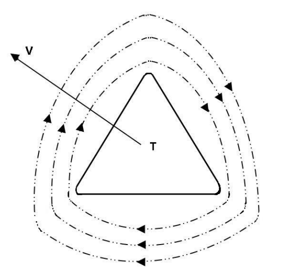
(d)


N
D$_1$
D$_2$
P$_1$
P$_2$

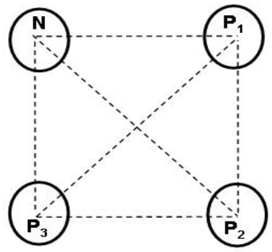
(e)


V
N
V
V
P$_1$
P$_2$

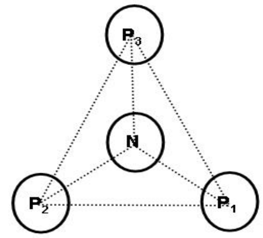
(f)


V
T

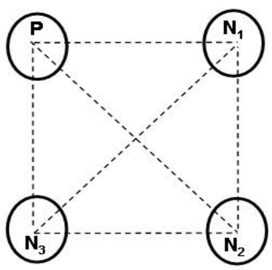
(g)



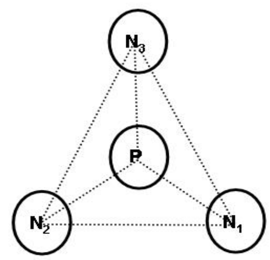
(h)



(i)



(j)



(k)

Fig. 5: In the structure of a nucleus of H^3: **(a)** arrangement of two-neutrons and one-proton each having linear velocity v; **(b)** formation of two deuterons D_1, D_2; **(c)** interaction between magnetic fields of nucleons. In the structure of a nucleus of He^3: **(d)** arrangement of one-neutron and two-protons each having linear velocity v; **(e)** formation of two deuterons D_1, D_2; **(f)** interaction between magnetic fields of nucleons. **(g)** Shape of the outer portion of the magnetic field obtained around the nuclei of H^3 and He^3, and the direction of linear velocity v obtained by them. **(h, i)** Arrangement of three-neutrons and one-proton, each having linear velocity v, in a nucleus of synthesized isotope H^4. **(j, k)** Arrangement of one-neutron and three-protons each having linear velocity v in a nucleus of isotope Li^4 **.**

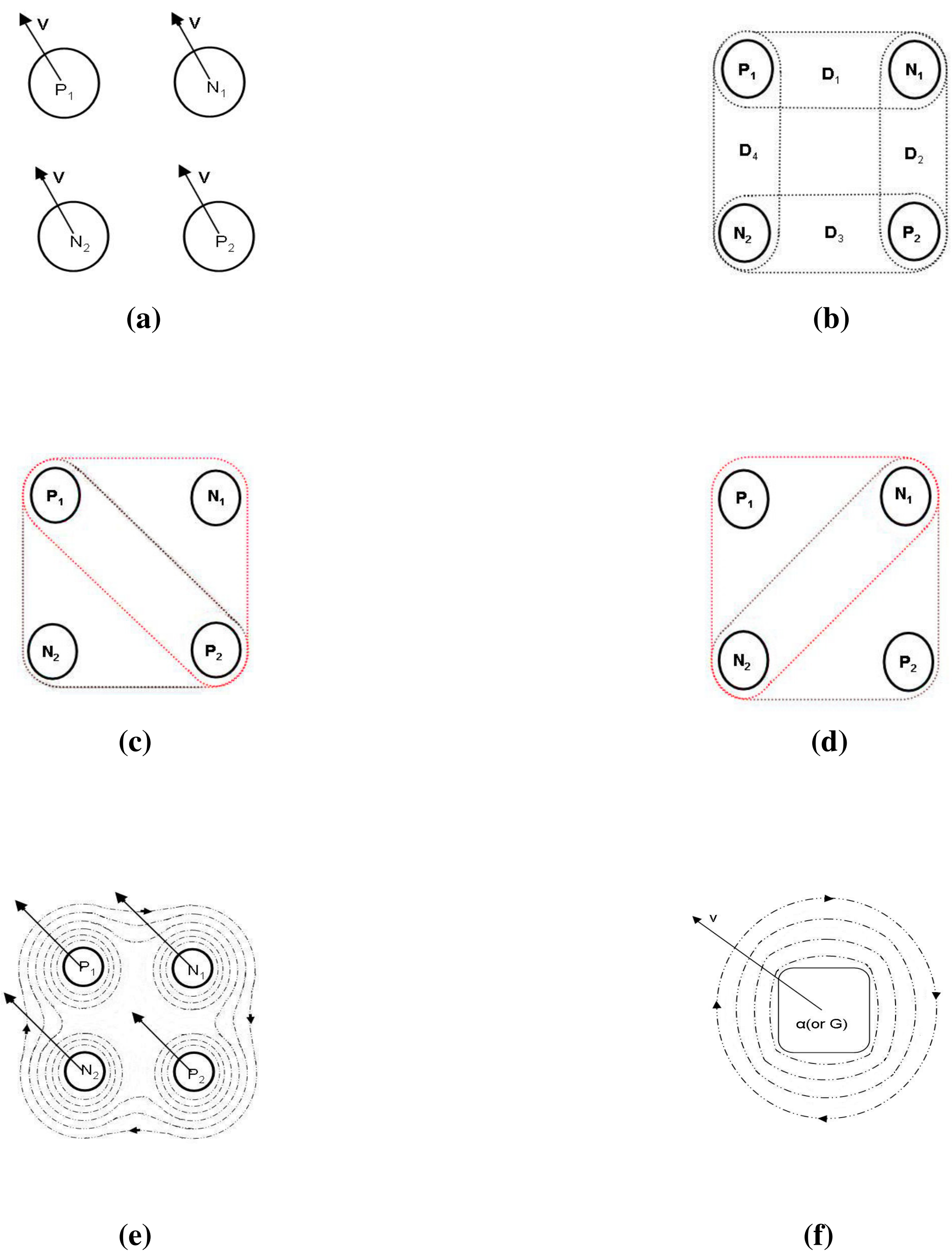
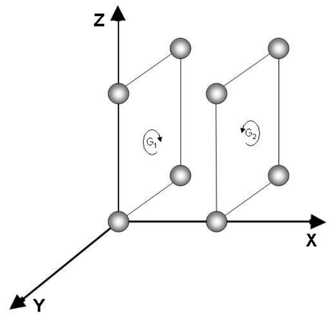
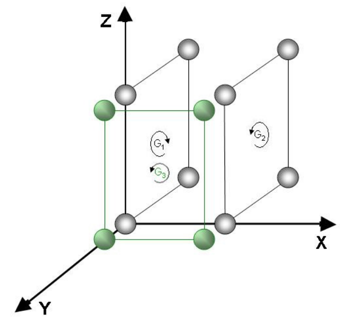


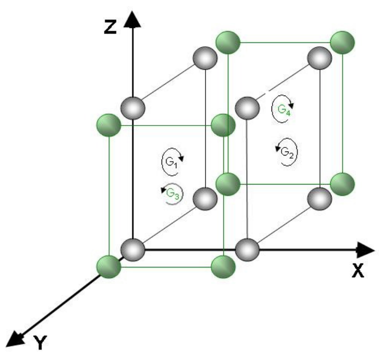
Fig. 6: In the structure of an alpha particle (or a group G): **(a)** arrangement of two-neutrons and two-protons each having linear velocity v; **(b)** formation of four deuterons D_1, D_2, D_3, D_4; **(c)** formation of two T_1 groups, **(d)** formation of two T_2 groups; **(e)** interaction between magnetic fields of nucleons; **(f)** shape of the outer portion of the magnetic field obtained around alpha particle (or group G) and the direction of linear velocity v obtained by it.



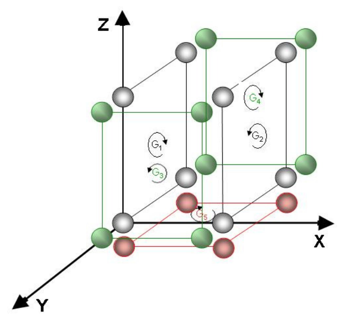
(a)



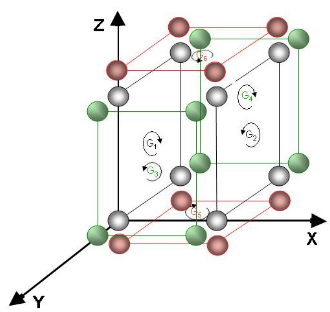
(b)



(c)

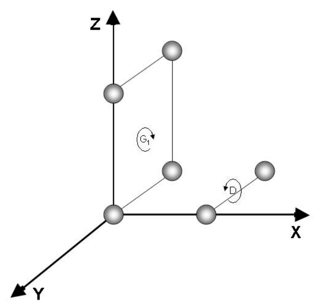


(d)

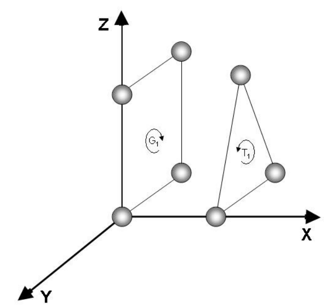


(e)

Fig. 7: Arrangement of nucleons in a nucleus: **(a)** of He^4, **(b)** of Be^8, **(c)** of C^{12}, **(d)** of O^{16}, **(e)** of Ne^{20}, and **(f)** of Mg^{24}.



(a)



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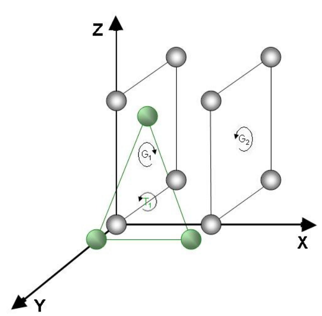

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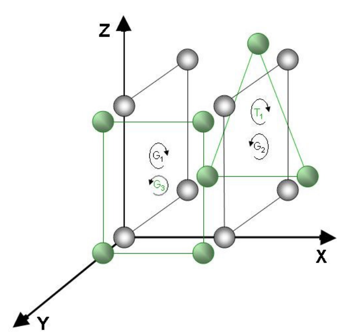

(d)

Fig. 8: Arrangement of nucleons in a nucleus: **(a)** of Li^{6} , **(b)** of Li^{7} , **(c)** of B^{11}, **(d)** of N^{14} **.**