A NEW NEUTRON MODEL

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Several neutron models, including standard quark model, have so far been proposed but yet we have no knowledge of, e.g.: 1. Why and how neutron happens to be unstable in its free state and what happens or situation is created such that it becomes stable in nuclei and systems, e.g. deuterons, alpha (α) particles etc.; 2. Why and how neutron has unstable and stable both the states, while the rest of all the elementary particles have only one state, stable or unstable; 3. Why and how neutron survives for about 15 minutes (mean life time of neutron) and then decays, while the rest of all the unstable elementary particles decay within fraction of a second; 4. Why and how neutron has high penetrating power and distinguishable low and high-energy ranges. Present model gives very clear and complete explanation of all the above questions including explanation of several other neutron properties and phenomena performed by neutrons, e.g.: 1. Magnetic moment of neutrons; 2. Electric dipole moment of neutrons; 3. How beta (β) particles, which are electrons, are emitted from nuclei during β decay while it is believed that electrons do not reside inside the nuclei; 4. Why and how β particles emitted from radioactive sources have continuous energy spectrum.

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1. INTRODUCTION

Several neutron models, including standard quark model, have so far been proposed but yet we have no knowledge of, e.g.: 1. Why and how neutron happens to be unstable in its free state and what happens or situation is created such that it becomes stable in nuclei and systems, e.g. deuterons, α particles etc.; 2. Why and how neutron has unstable and stable both the states, while the rest of all the elementary particles have only one state, stable or unstable; 3. Why and how neutron survives for about 15 minutes (mean life time of neutron) and then decays, while the rest of all the unstable elementary particles decay within fraction of a second; 4. Why and how neutron has high penetrating power and distinguishable low and high-energy ranges.

The above observations about neutron are important and hence we must have their explanation. The inability of the current neutron models to explain the above observations is their great drawback.

The standard quark model[1,2] though explains several properties of neutron but gives rise to numerous very basic and fundamental questions. For example, according to quark model, neutron decays into a proton, electron (β^-), and antineutrino via an intermediate W^- boson, as shown in Fig. 1. But this explanation gives rise to numerous very basic and fundamental questions (see Sec. 3.10). Secondly, according to quark model[3], β^- particles are emitted from neutrons as the consequence of decay of their down quarks into up quarks, Fig. 1. And β^+ particles are emitted from protons as the consequence of decay of their up quarks into down quarks. If β^+ particles are emitted from protons as the consequence of decay of their up quarks into down quarks, then protons too should be unstable as neutrons are unstable, while on the contrary, protons are stable particles.

Therefore, presently, a new neutron model has been proposed. It enables to give very clear and complete explanation of all the properties of neutron mentioned above including explanation of rest of other neutron properties too, e.g.: 1. Magnetic moment of neutrons; 2. Electric dipole moment of neutrons; 3. How β particles, which are electrons, are emitted from nuclei during β decay while it is believed that electrons do not reside inside the nuclei; 4. Why and how β particles emitted from radioactive sources have continuous energy spectrum.

2. PRESENT NEUTRON MODEL

In the structure of neutron, there occur actually one proton and one electron, and proton and electron are so set that their setting enables neutron to exhibit all the properties mentioned above in Sec. 1. (How such setting of proton and electron is obtained, see Sec. 2.1.)

The current concept about the structures of electrons and protons is not true. Currently it is believed that electron and proton both possess magnetic moment (μ_S) and magnetic field around those due to spin motion of their charge. But it is not true (for its confirmation, see Sec. 1, Ref. 4).

Electron (and similarly proton, see onwards) possesses a bundle of magnetism too by the virtue of nature similarly as it possesses a bundle of charge ($-e$) by the virtue of nature (for detail, see Sec. 2, Ref. 4). This magnetism occurs in the form of a circular ring, shown by a dark solid line circle around the charge of electron where charge has been shown by a spherical ball, Fig. 2(a), as for example, there occur rings around the planet Saturn. Around the charge of electron, there occurs its electric field (which has not been shown in Fig.), and around magnetism of electron, there occurs its magnetic field shown by broken line circles, Fig. 1(a). The magnetism and charge of electron both spin, but in directions opposite to each other, shown by arrows in opposite directions, Fig. 1(b), where the ball of charge has been shown by quite a thick dark line circle and magnetism by comparatively a thinner dark line circle. The magnetic moment (μ_s), which is currently defined as spin magnetic moment of electron, arises due to the spin motion of this magnetism and occurs in the direction of its (magnetism) spin angular momentum.

The magnetism and charge of electron spin in directions opposite to each other because then their respective fields interact (electromagnetic interaction) with each other such that their spin motion in directions opposite to each other persists, and it keeps electron going on spinning persistently. (For detail and justification of its truth, see Sec. 3.1, Ref. 5.)

The frequencies of spin motion of the ball of charge (ω_{EC}) and the ring of magnetism (ω_{EM}) of electron are happened to be such that the generated spin angular momentum (L_{SC}) and linear velocity (v_{EC}) in the charge of electron along the direction of its L_{SC} are greater than the generated spin angular momentum (L_{SM}) and linear velocity (v_{EM}) in the magnetism of electron along the direction of its L_{SM}, i.e. $L_{SC} > L_{SM}$ and v_{EC}

$> v_{EM}$. (The velocities v_{EC} and v_{EM} in the ball of charge and the ring of magnetism respectively are generated because spin motion of spinning particle/body generates two properties in those, and due to these properties, v_{EC} and v_{EM} are generated, for detail, see Sec. 2, Ref. 5.) The spin angular momentum L_S, which the electron as whole possesses, happens to be the resultant of L_{SC} and L_{SM}, i.e. L_S = L_{SC} - L_{SM}. Consequently, electron possesses linear velocity v_E along the direction of its L_S and the magnitude and direction of its v_E vary as the frequencies of spin motion ω_{EC} and ω_{EM} vary. The frequency ω_E corresponding to the resultant spin angular momentum L_S, can be said to be the frequency of spin motion of electron.

Further, since μ_s occurs along the direction of L_{SM} and the electron possesses its linear velocity v_E along the direction of its L_S which (v_E) lies along L_{SC}, μ_s lies in direction opposite to the direction of L_S because L_{SC} and L_{SM} lie in directions opposite to each other.

The proton too possesses similarly a bundle of magnetism by the virtue of nature similarly as it possesses a bundle of charge $+e$ by the virtue of nature (for detail, see Sec. 3.2, Ref. 5). The magnetism and charge of proton both spin but in directions opposite to each. And the spin magnetic moment (μ_s), which the proton possesses, arises due to the spin motion of this magnetism, and occurs in the direction of its (magnetism) spin angular momentum.

The proton possesses linear velocity v_P too along the direction of its L_S and the magnitude and direction of its v_P vary as the frequencies of spin motion ω_{PC} and ω_{PM} vary similarly as happens with electron. The frequency ω_P corresponding to the resultant spin angular momentum L_S, can be said to be the frequency of spin motion of proton. The spin magnetic moment of proton (μ_s) lies in direction opposite to the direction of its L_S similarly as happens with electron.

2.1 How one proton and one electron are set such that these constitute a neutron

Since electron and proton both possess linear velocity v_E and v_P respectively, if an electron and a proton are moving exactly along the same line but in directions opposite to each other, those front on collide with each other. But due to spin motion of charges and hence of electric fields round the charges of electron and proton in directions opposite to each other, the charges of electron and proton do not become able to come in contact with each other. A very fine space is left between those. When those collide, since the proton happens to be much heavier (about 2×10^3 times) than the electron, proton is neither being pushed behind nor it stops moving. It goes on moving forward in the direction of its linear motion but its velocity is of course being reduced, say to v'_P. The electron stops moving forward and its velocity is being reduced to zero. (After collision, how energy, momentum etc. of electron and proton conserve, see Sec. 9.2.3, Ref. 6) Then obviously it is dragged along with proton in the direction of linear motion of proton.

After collision with proton, since the velocity of electron is reduced to zero, the frequency of spin motion of its ball of charge, i.e. ω_{EC}, starts decreasing according to expression[7]:

$$m\text{v}^2 = h\omega \quad \text{.......} \qquad (1)$$

where h is Planck's constant, $m, \text{v}, and\, \omega$ respectively are the mass, linear velocity and frequency of spin motion of the particle [for verification of the truth of Eqn. (1), see Sec. I A, Ref. 7]. The frequency of spin motion ω_{EC} goes on decreasing but very gradually. After some time say t_1, ω_{EC} is reduced as much that L_{SC} becomes = L_{SM}. After that, as ω_{EC} decreases, L_{SM} starts becoming greater than L_{SC}, i.e. L_{SM} - L_{SC} starts increases. After some time say t_2, a stage comes when L_{SM} - L_{SC} is increased as much that the electron becomes able to move in the direction of its L_{SM} with velocity greater than the velocity of proton. Then the electron is separated from the proton even against the attractive Coulomb force on it by the proton, i.e. neutron decays into a proton emitting an electron. (If by some means, the separation of electron from the proton is stopped, the neutron becomes stable. The same thing, i.e. stopping of separation of electron from the proton happens in all the stable systems: deuterons, alpha particles and nuclei, see Sects. 4, 5, 6, Ref. 6. But how it happens, see Sec. 4.1, Ref. 6.)

After separation of electron from the proton, a situation comes when ω_{EC} starts increasing again, and during the course of motion of electron along the direction of its L_{SM}, a stage comes when ω_{EC} of electron is increased as much that 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 its L_{SC}, it starts moving again along it L_{SC}, i.e. towards the proton, and may combines with proton if it is not being ejected from its path by some means, as for example happens during the process of β decay (see Sec. 9.2.1, Ref. 6).

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 those are separated from each other, i.e. $t_1 + t_2 = t$ happens to be the mean life time of neutron.

3.2 Why and how mean life time of neutron happens to be about 15 minutes

After collision of electron with proton when the velocity of electron is reduced to zero and its ω_{EC} starts decreasing, since the decrease in ω_{EC} takes place gradually, $t_1 + t_2 = t$ happens to be quite significant, of the order of about 15 minutes.

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 stable nuclei and systems, the separation of electron from the proton is stopped (how the separation is stopped, see Sec. 4.1, Ref. 6), consequently 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 spin magnetic moment (μ_s) of a spinning particle having charge q, mass m, and spin angular momentum L_s, since neutron has charge = 0, its spin magnetic moment (μ_{sn}) should be zero. While on the contrary, neutron has spin magnetic moment μ_{sn} (= -0.00966236×10^{-24} J/T). 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 μ_s give respectively the charge = 0 and μ_{sn} = -0.00966236×10^{-24} J/T for neutron.

But which are those particles which constitute neutron and possess equal and opposite charge and μ_s. It is possible that some people may argue that the constituent particles of neutron possess equal and opposite charge but possess no μ_s. Due to spin motion of their combination, i.e. neutron, it obtains its μ_{sn}. But it gives rise to several questions, e.g.: 1. Which are those such particles? 2. When the net charge q of the combination becomes = 0, μ_s of neutron should be = 0 according to expression $\mu_s = (q/2m)L_s$, how can neutron have μ_{sn}? Therefore, the above argument is ruled out.

The particles which constitute neutron are one proton and one electron (see Sec. 2). Electron and proton have charge $-e$ and $+e$, and spin magnetic moment μ_{se} and μ_{sp} respectively (see Sec. 2), and when combining with each other those constitute a neutron, the net charge of neutron becomes = 0 and the net spin magnetic moment (**μ_{sn}**) = **$\mu_{sp} \pm \mu_{se}$**. In the structure of neutron, since the directions of L_{sm} of electron and proton are in opposite directions (see Sec. 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 μ_{sn} should be = μ_{se} (= $-9.2847637\times10^{-24}\ J/T$) **-** μ_{sp} (= 0.01410607×10^{-24} J/T) = $-9.27065768\times10^{-24}$ J/T, and it should occur in the direction of μ_{se} because μ_{se} **>** μ_{sp}. The experimental value of μ_{sn} = $-0.00966236\times10^{-24}$ J/T has same sign as the presently obtained value of μ_{sn} has, but in magnitude, it 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} might be due to having about 2×10^{3} times more mass by the proton in comparison to that of the electron. Since 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 ruled out because, as the net charge of neutron is zero, it means, when electron and proton combine with each other, though those 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

< μ_{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 Electric dipole moment of neutron

When an electron combining with a proton constitute a neutron, those do not merge into a single particle but due to spin motion of electric fields round their charges in directions opposite to each other, a very fine space is left between their charges (see Sec. 2.1). And thus an electric dipole is created within the neutron and it (neutron) obtains electric dipole moment.

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

Electrons do not reside inside the nuclei independently in the manner as protons and neutrons reside. Electrons reside inside the neutrons and constitute neutrons combining with protons. And when electrons are separated from protons as has been described in Sec. 2.1, if these are ejected by some means (see Sec. 9.2.1, Ref. 6), then only these are emitted from the nuclei in the form of β particles, otherwise not.

3.7 Why and how beta particles emitted from radioactive sources have continuous energy spectrum

During the course of motion of electron (after its separation from proton) along the direction of its L_{SM} (see Sec. 2.1), say during time t', the energy of electron goes on varying continuously due to variation in its ω_{EC} and ω_{EM} . And when the difference (L_{SC} - L_{SM}) is increased as much that the electron can move towards its L_{SC} and it starts moving again along it L_{SC} (see Sec. 2.1), during this course of time say t'' too, the energy of electron goes on varying continuously. Suppose if electrons of different instants during time $t' + t''$ are ejected from the radioactive sources, there shall be obtained a large number of electrons, i.e. β particles of continuously varying energy. And consequently, β particles emitted from radioactive sources have continuous energy spectrum.

3.8 Why and how 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 or 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 electron lies always in front of proton during its (proton) motion, and electron is much lighter than the proton, the electron shall be smaller too. Then 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, since electron and proton both possess spin motion, neutron possesses motional energy M.E. [= K.E. (kinetic energy) + S.E. (spin energy}] = M.E. of proton + M.E. of electron, and motional momentum M.M. [= L.M. (linear momentum) + S.M. (spin momentum)] = M.M. of proton + M.M. of electron (for detail, see Sec. 2, Ref. 5). Due to presence of electron, since neutron possesses additional M.E. and M.M., the power of penetration of neutrons is increased.

The possession of zero net charge by neutron may also be one of the reasons behind having high penetrating power by those.

3.9 Why and how neutron has distinguishable low and high energy ranges

When the electron collides with proton of neutron, due to their collision, the energy of proton and hence of neutron is decreased. After collision, as ω_{EC} starts decreasing (see Sec. 2.1), the effect of collision on proton of neutron goes on decreasing subsequently the magnitude of decrease in energy of proton and hence of neutron goes on reducing. After time t_1, i.e. when L_{SC} becomes = L_{SM}, the decrease in energy of neutron reduces to minimum value. After that, as L_{SM} - L_{SC} starts increasing, the energy of neutron starts increasing because then in the electron, the tendency of motion in the direction of motion of proton is developed. And at the time when electron is about to be separated from proton, the energy of neutron is increased to its maximum value.

If from a system or source of neutrons, neutrons of different instants, during which ω_{EC} of neutrons was decreasing (i.e. during time t_1), are emitted, the emitted neutrons are happened to be of distinguishable low energy range. And if neutrons of different instants, during which L_{SM} - L_{SC} of neutrons had started increasing (i.e. during time t_2), are emitted, the emitted neutrons are happened to be of distinguishable high energy range.

3.10 Discussion

According to Quark model[2], neutron is composed of two down quarks (d_1 and d_2), each having charge −e/3 and mass 4.1 to 5.8 MeV/c^2, and one up quark (u), having charge +2e/3 and mass 1.7 to 3.3 MeV/c^2, and thus has zero net charge. And a proton is composed of one down quark (d) and two up quarks (u_1 and u_2) and thus has +e net charge. The up and down quarks in neutron and proton are arranged as shown in Fig. 1. According to this model, a down quark d_2 decays into a lighter up quark u_2 emitting a virtual W^- boson[2] having charge[8] -e and mass[8] 80.398 ± 0.023 GeV/c^2, and W^- boson decays into an electron (β^-) and an antineutrino, Fig. 1. But this model gives rise to several questions, e.g.: How does the down quark d_2 decay into lighter up quark u_2 emitting a virtual W^- boson? Suppose if it is argued that it occurs due to weak interaction[2], then the questions arise, does the weak interaction take about 15 minutes? Or especially in this case does it take about 15 minutes? If especially in this case it take about 15 minutes then 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? The electrostatic Coulomb interaction happens to be much stronger than the weak interaction, then how does the weak interaction come into play overruling or overcoming the electrostatic Coulomb interaction? If the weak interaction takes place within the quark d_2 itself, then how, why and what does happen within the quark d_2 such 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. How, by which mechanism and/or according to which scientific (physical/chemical) law, do the above phenomena/events take place? As the consequence of decay of a quark d_2 into a quark u_2, the emission of a real particle of mass (4.1 to 5.8 - 1.7 to 3.3) MeV/c^2 can be assumed, or, according to mass-energy equivalence principle (theory of relativity), the emission of an energy (4.1 to 5.8 - 1.7 to 3.3) MeV can be assumed, but the occurrence of the above events is very hard to believe and accept.

Furthermore, 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 these are inter-convertible. In which category does the virtual W^- boson lie?

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FIGURE CAPTIONS

Fig. 1: The Feynman diagram for β decay of a neutron into a proton, electron, and antineutrino via an intermediate W^- boson.

Fig. 2: (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.

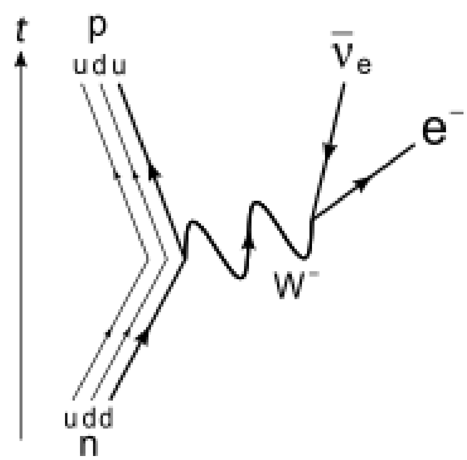
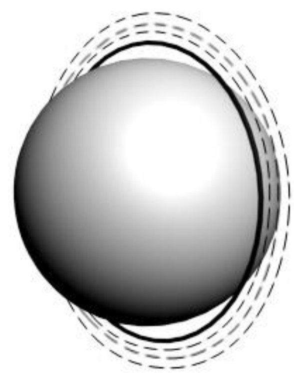
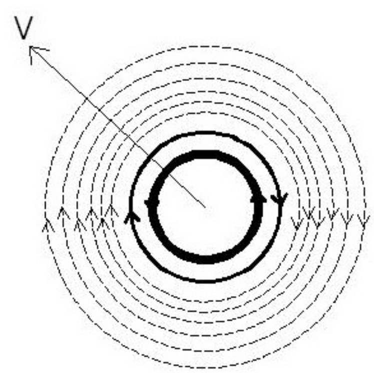


Fig. 1



(a)



(b)

Fig. 2