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 (\(\alpha\)) 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 (\(\beta\)) particles, which are electrons, are emitted from nuclei during \(\beta\) decay while it is believed that electrons do not reside inside the nuclei; 4. Why and how \(\beta\) 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\textsuperscript{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\textsuperscript{−}), and antineutrino via an intermediate W\textsuperscript{−} 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\textsuperscript{3}, β\textsuperscript{−} particles are emitted from neutrons as the consequence of decay of their down quarks into up quarks, Fig. 1. And β\textsuperscript{+} particles are emitted from protons as the consequence of decay of their up quarks into down quarks. If β\textsuperscript{+} 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 $\beta$ particles, which are electrons, are emitted from nuclei during $\beta$ decay while it is believed that electrons do not reside inside the nuclei; 4. Why and how $\beta$ 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 ($\mu_s$) 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 (µs), 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 (ωEC) and the ring of magnetism (ωEM) of electron are happened to be such that the generated spin angular momentum (LSC) and linear velocity (vEC) in the charge of electron along the direction of its LSC are greater than the generated spin angular momentum (LSM) and linear velocity (vEM) in the magnetism of electron along the direction of its LSM, i.e. LSC > LSM and vEC
> \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 \(\omega_{EC}\) and \(\omega_{EM}\) vary. The frequency \(\omega_E\) corresponding to the resultant spin angular momentum \(L_S\), can be said to be the frequency of spin motion of electron.

Further, since \(\mu_s\) 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 \(L_{SC}\), \(\mu_s\) 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 (\(\mu_s\)), 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 $\omega_{pc}$ and $\omega_{pm}$ vary similarly as happens with electron. The frequency $\omega_p$ 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 ($\mu_s$) 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 $2 \times 10^3$ 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. $\omega_{EC}$, starts decreasing according to expression\(^7\):

$$mv^2 = h \omega$$

where $h$ is Planck’s constant, $m, v, and \omega$ 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 $\omega_{EC}$ goes on decreasing but very gradually. After some time say $t_1$, $\omega_{EC}$ is reduced as much that $L_{SC}$ becomes $= L_{SM}$. After that, as $\omega_{EC}$ 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 $\omega_{EC}$ starts increasing again, and during the course of motion of electron along the direction of its $L_{SM}$, a stage comes when $\omega_{EC}$ 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 $\beta$ 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 $\omega_{EC}$ starts decreasing, since the decrease in $\omega_{EC}$ 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 ($\mu_s$) of a spinning particle having charge $q$, mass $m$, and spin angular momentum $L_s$, since neutron has charge $= 0$, its spin magnetic moment ($\mu_{sn}$) should be zero. While on the contrary, neutron has spin magnetic moment $\mu_{sn} (= -0.00966236 \times 10^{-24} \text{ J/T})$. 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 $\mu_s$ such that the resultants of their charge and $\mu_s$ give respectively the charge $= 0$ and $\mu_{sn} = -0.00966236 \times 10^{-24} \text{ J/T}$ for neutron.

But which are those particles which constitute neutron and possess equal and opposite charge and $\mu_s$. It is possible that some people may argue that the constituent particles of neutron possess equal and opposite charge but possess no $\mu_s$. Due to spin motion of their combination, i.e. neutron, it obtains its $\mu_{sn}$. 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 $= 0$, $\mu_s$ of neutron should be $= 0$ according to expression $\mu_s = (q/2m)L_s$, how can neutron have $\mu_{sn}$? 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 \(\mu_{se}\) and \(\mu_{sp}\) 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 \((\mu_{sn}) = \mu_{sp} \pm \mu_{se}\).

In the structure of neutron, since the directions of \(L_{sn}\) of electron and proton are in opposite directions (see Sec. 2), and the directions of \(\mu_{se}\) and \(\mu_{sp}\) of electron and proton lie respectively in the directions of their \(L_{sn}\), \(\mu_{se}\) and \(\mu_{sp}\) lie in directions opposite to each other. And hence \(\mu_{sn}\) should be \(\mu_{se} = -9.2847637 \times 10^{-24} \text{ J/T}\) - \(\mu_{sp} = 0.01410607 \times 10^{-24} \text{ J/T}\) = \(-9.27065768\times10^{-24} \text{ J/T}\), and it should occur in the direction of \(\mu_{se}\) because \(\mu_{se} > \mu_{sp}\). The experimental value of \(\mu_{sn} = -0.00966236 \times 10^{-24} \text{ J/T}\) has same sign as the presently obtained value of \(\mu_{sn}\) has, but in magnitude, it is much lesser (about \(7 \times 10^{7}\)) than the theoretical value \((-9.27065768 \times 10^{-24} \text{ J/T})\). The reason is probably as follows:

The proton has same amount of charge (+e) as the electron has (-e), but \(\mu_{sp}\) is about \(2 \times 10^3\) times lesser than \(\mu_{se}\). The decrease of about \(2 \times 10^3\) times in the value of \(\mu_{sp}\) might be due to having about \(2 \times 10^3\) times more mass by the proton in comparison to that of the electron. Since neutron too is about \(2 \times 10^3\) times more massive than the electron, \(\mu_{sn}\) is reduced by about \(7 \times 10^2\) 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 \(\mu_{sn}\) is a little
while $m_n$ (mass of neutron = $1.6749 \times 10^{-27}$ Kg) is a little greater than $m_p$ (mass of proton = $1.6726 \times 10^{-27}$ Kg), it confirms that due to increase in mass of the resultant system (i.e. neutron) by about $2 \times 10^3$ times, $\mu_m$ is reduced by about $7 \times 10^3$ 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 $\beta$ 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 $\omega_{EC}$ and $\omega_{EM}$. 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. $\beta$ particles of continuously varying energy. And consequently, $\beta$ 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 $\omega_{ec}$ 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 $\omega_{ec}$ 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\textsuperscript{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\textsuperscript{2}, and one up quark ($u$), having charge $+2e/3$ and mass $1.7$ to $3.3$ MeV/c\textsuperscript{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\textsuperscript{2} having charge\textsuperscript{8} $-e$ and mass$^8$ $80.398 \pm 0.023$ GeV/c\textsuperscript{2}, and $W^-$ boson decays into an electron ($\beta^-$) 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\textsuperscript{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 $10^i$ 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 $\beta^-$, 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 ($\beta^-$) 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 $\beta$ 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