A new neutron model

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Because all electrons, nucleons, and other particles undergo a persistent spin motion without having any source of infinite energy, they should have a unique structure that keeps them persistently spinning and provides all the properties that they display. In addition, there should be some reason or purpose why they show a persistent spin motion, because, in nature, nothing occurs without a reason or purpose. Research on the present topic attempts to determine the unique structure of neutron, how neutron possesses a persistent spin motion through its unique structure, and the purpose why it has such persistent spin motion. These determinations provide very clear and complete explanation of all the properties of neutrons, including two very important properties about which the people were not known before, as well as all properties and structures of their (neutrons) systems, e.g., deuterons, alpha particles, and nuclei, generated due to them.

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1 Introduction

As we know, in nature, nothing occurs without a reason or purpose. For example, our hearts persistently beat without having a source of infinite energy, which does not happen without a reason because an important reason exists as to why our hearts beat, in addition to why they have a unique structure that keeps them persistently beating and hence provides all the properties that they display. Therefore, because all electrons, nucleons, and other particles possess a persistent spin motion without having any source of infinite energy, some reason or purpose should exist why they show a persistent spin motion. In addition, such particles should have unique structures that keep them persistently spinning and provide all the properties that they display.

Further, as we know, all phenomena or activities related to our hearts, e.g., continuous blood circulation in our bodies, are the consequences of the purpose behind the persistent beating of our hearts, their unique structure, and their properties. Similarly, all the phenomena or activities related to electrons, nucleons, and other particles should have been the consequences of the purpose behind their persistent spin motion, their unique structures, and their properties.

Therefore, unique structures of electrons, and protons, their properties (see Section 3, [1]), and purpose as to why they display a persistent spin motion (see Section 2, [1]) have been determined. In the present study, unique structure of neutrons (Section 2), and how their unique structure provides persistent spin motion (Section 2.1) and other properties to them that they display (see Section 3) have been determined. The properties of neutrons, included in this study, are listed below:

1) Neutrons survive for approximately 15 min (mean lifetime of a neutron) before their decay; whereas the rest of all the unstable elementary particles decay within fraction of a second (see Section 3.1).

2) Neutrons have both unstable and stable states; whereas the rest of all the elementary particles have only one state, either stable or unstable (see Section 3.2).

3) Neutrons possess a magnetic moment = – 0.00966236×10^{-24} J/T (see Section 3.3).

4) Neutrons possess an electric dipole moment (see Section 3.4).

5) Neutrons have a high penetration power (Section 3.5).

6) Neutrons have distinguishable low and high energy ranges (see Sections 3.6).

The following two very important properties, about which the people were not known before, have also been included in this study:

1) Occurrence of neutrons always in moving state (see Section 3.7).

2) Possession of motional energy (E_M) and motional momentum (p_M) by neutrons (see Section 3.8).

The present neutron model provides very clear and complete explanations of all the properties and structures of their systems, e.g., deuterons, alpha particles, and nuclei (see Section 4), which are caused due to properties of neutrons.

, Currently, several neutron models have so far been proposed, but they, including standard quark model, fail to explain most of the properties mentioned above of neutrons. They fail also to explain properties and structures of their systems, e.g., deuterons, alpha particles and nuclei, which are caused due to properties of nucleons.

If we investigate the standard quark model [2, 3], we find that, in this model, in order to arrive at the desired results, several concepts, which are practically and logically unbelievable, have been accepted. For example:

According to quark model, neutron is composed of two down (d) quarks, each having charge −e/3 and mass 4.8 MeV/c^2, and one up (u) quark, having charge +2e/3 and mass 2.3 MeV/c^2, and thus has zero net charge, and a proton is composed of one down (d) quark and two up (u) quarks and thus has +e net charge. As the consequence of decay of a down quark (d) of neutron into an up quark (u), Fig. 1, β^- particle is emitted from neutron, and β^+ particle is emitted from proton as the consequence of decay of it's an up (u) quark into a down (d) quark. Then protons should also be unstable as neutrons are unstable, while on the contrary, protons are stable particles. Moreover, when a down quark (d) decays into a lighter up quark (u), a virtual W^-boson [4] having charge (-e) and mass 80.385 GeV/c^2 is emitted, and W^- boson decays into an electron (β^-) and an antineutrino, Fig. 1. The assumptions:

1) decay of quark d, having charge −e/3, into a quark u, having charge +2e/3, emitting a virtual W^- boson;

2) even being a virtual particle, the possession of mass (80.385 GeV/c^2) by W^- boson, that too about 10^4 times more than the mass (4.8 MeV/c^2) of the mother quark d;

3) even being a virtual particle, the possession of charge by W^- boson, that too –e, while the mother quark d has only charge −e/3;

4) decay of virtual W^- boson, which does not exist physically, into a real electron β^-, which exists physically;

are logically and practically unbelievable. How and by which mechanism, and/or according to which scientific (physical/chemical) law, do the above phenomena/events occur? As the consequence of decay of a quark d into a quark u, the emission of a real particle of mass (4.8 - 2.3) MeV/c^2 can be assumed, or, according to mass-energy equivalence principle (theory of relativity), the emission of an energy (4.8 - 2.3) MeV can be assumed to be possible, but the above assumptions {bullets 1) to bullet 4)} cannot be assumed possible, because they are logically and practically unbelievable.

Further, what are the physical interpretations of: 1) emission of virtual W^- boson; 2) possession of mass and charge by virtual W^- boson, which physically does no exists; 3) emission of a virtual W^- boson as the consequence of decay of a real quark d; 4) decay of virtual W^-boson into a real electron (

β^-)? As far as the author's knowledge is concerned, it is believed that, in universe, there exist only matter and energy, in which category does the virtual W^- boson lie?

2 The present neutron model

A neutron is actually a combination of an electron and a proton. This combination happens to be such that it behaves as a single particle in nuclei as well as outside the nuclei, similarly, as a proton behaves.

How an electron and a proton, combing with each other, constitute a neutron is as follows:

An electron and a proton, whenever and wherever (e.g., in their systems, or in atmosphere, or in space) are found moving along the same line but in directions opposite to each other, they front on collide with each other. However, according to unique structures of electrons and protons {see Sections 3.1, and 3.2, [1] and Fig. 1(b), [1]}, electron and proton each possesses a ball of charge, around which a ring of magnetism occurs, and the ball of charge and ring of magnetism of each electron and proton spin but in directions opposite to each other, as a result of which, the electrons and protons are found always in moving state moving with linear velocity $\mathrm{v_E}$ and $\mathrm{v_P}$, respectively, along the directions of their respective L_S, and they possess motional energy E_M (= kinetic energy E_K + spin energy E_S) and motional momentum p_M (= linear momentum p_{LIN} + spin momentum p_S) (see Section 2, [1] for detail information). The electrons are found moving with velocity $\mathrm{v_E}$ in both forward and backward directions, however their motion in forward direction occurs normally, and in backward direction occurs only under special circumstances (see Section 3.1, [1] for detail information). When $\mathrm{v_E} = \mathrm{v}_{EC} - \mathrm{v}_{EM}$, $\mathrm{v_E}$ occurs in the direction of v_{EC} (i.e. in forward direction), and when $\mathrm{v_E} = \mathrm{v}_{EM} - \mathrm{v}_{EC}$, $\mathrm{v_E}$ occurs in the direction of v_{EM} (i.e. in backward direction), where v_{EC} is the linear velocity generated in the ball of charge of the electron due to frequency of its (ball of charge) spin motion ω_{EC} and varies as ω_{EC} varies, and v_{EM} is the linear velocity generated in the ring of magnetism of the electron due to frequency of its (ring of magnetism) spin motion ω_{EM} and varies as ω_{EM} varies (see Section 3.1, [1] for detail information). The electrons are found moving normally in forward direction, therefore, when an electron front on collides with a proton, v_E occurs in forward direction (i.e. in the direction of v_{EC}).

Further, according to unique structures of electrons and protons {see Sections 3.1, and 3.2, [1] and Fig. 1(b), [1]}: 1) the planes of their magnetic rings and magnetic ring's magnetic fields occur in a plane perpendicular to the directions of their respective linear velocity; 2) the directions of their spin magnetic moments (μ_S) occur opposite to the directions their respective linear velocity; and 3) the directions of spin motion of their rings of magnetism and magnetic ring's magnetic fields occur in clockwise direction (if the directions of their linear velocity are opposite to the face of clock).

Therefore, when an electron front on collides with a proton, the direction of spin motion of the electron's ball of charge and its (ball of charge) electric field is found opposite to the direction of spin motion of the proton's ball of charge and its (ball of charge) electric field. The spin motions of electric fields of ball of charge of both electron and proton in directions opposite to each other do not let their balls of charge to touch each other during their collision. A very fine space is left between them. (However, when the electron and proton front on collide with each other with a force such that the fine space is not left between their balls of charge; they merge into a single particle. Their merger is an important incident, rather to say event, because it provides a plausible solution to a very challenging and important problem of space scientific. Its detail study shall be provided later on.)

When the ball of charge of electron collides with the ball of charge of proton leaving a very fine space between them, because the proton happens to be much massive (about 2×10^3 times) than the electron, the proton is neither being pushed behind nor it stops moving forward. It goes on moving forward in the direction of its linear motion but its linear velocity v_P and energy E_P are of course being reduced, say to v_P' and E_P' respectively. The electron of course stops moving forward and its linear velocity v_E is being reduced to zero. (After collision, how energy, momentum etc. of electron and proton conserve, see bullet d) of Section 3.6.2, [5]) Then, obviously, the electron is dragged along with proton in the direction of its (proton) linear motion.

After collision of electron with proton, when the velocity v_E of electron is reduced to zero, the frequencies of spin motion of its ball of charge (ω_{EC}) and ring of magnetism (ω_{EM}) do not reduce to zero because practically it is not possible. The ω_{EC} starts reducing, but reduces gradually. When electron collides with proton, during that time, because the electron was moving along the direction of v_{EC}, which (v_{EC}) is generated in the ball of charge of the electron due to ω_{EC} and varies as ω_{EC} varies, therefore, after some time t_1, as the result of gradual reduction in ω_{EC}, a stage comes when ω_{EC} is reduced as much that the linear velocity v_{EC}, which would have generated in the ball of charge of the electron if the electron had not collided with proton and it (electron) had been free to move onwards, after reducing becomes = the linear velocity v_{EM}. After that (i.e., t_1), as ω_{EC} decreases further, v_{EM} starts becoming greater than v_{EC}, i.e. $v_{EM} - v_{EC}$ starts increasing and the electron obtains tendency to move in the direction of v_{EM} (i.e., in backward direction), and after some time t_2, a stage comes, when $v_{EM} - v_{EC}$ is increased as much that it ($v_{EM} - v_{EC}$) may become greater than the velocity of proton. Then the electron may be separated from the proton even against the attractive Coulomb force on it by the proton, i.e. neutron may decay into a proton emitting an electron.

By some means, if the separation of electron from proton is stopped, the neutron may become stable. The stopping of separation of electron from proton is being performed in case of all the neutrons in all the stable systems- deuterons, alpha particles, and nuclei. (How the stopping of separation of electrons from protons is being performed, see Section 3.1.1, [5].) Moreover, as strongly the stopping of separation is being performed in their systems (deuterons, alpha particles, and nuclei), accordingly, neutrons are found to be more and more stable in them (systems). In their systems, in which the stopping of separation happens to be weak, e.g., di-neutron and tritium (^{3}H), di-neutron does not exist in nature (see Section 3.1.3, [5]), and ^{3}H decays into helium-3 (^{3}He) through β decay, despite the E_b (binding energy per nucleon) of ^{3}H > the E_b of ^{3}He (see Section 3.2.6, [5]). Moreover, in nuclei, when their mass number (A) becomes > 200, there is created circumstance(s) such that the stopping of separation of electrons from protons of their (nuclei) neutrons becomes weak and the nuclei become radioactive (see Section 3.6.2, [5] for detail information).

If the stopping of separation of electron from proton of neutron does not happen to be possible, e.g. in free neutrons, they (free neutrons) decay after their mean life time ($= t_1 + t_2$ = about 15 minutes).

2.1 How the unique structure of neutrons keeps them spinning persistently

As an electron, due to its $\mathrm{v_{EC}}$ and $\mathrm{v_{EM}}$, obtains $\mathrm{v_E}$ ($= \mathrm{v}_{EC}$ - v_{EM}), and corresponding to its $\mathrm{v_E}$, it obtains frequency of spin motion ω_E according to expression [6] ($\mathrm{v}^2 = h\,\omega / m$) {see Section 3.1, [1] for detail information}, and proton, due to its $\mathrm{v_{PC}}$ and $\mathrm{v_{PM}}$, obtains v_P ($= \mathrm{v_{PC}}$ - $\mathrm{v_{PM}}$), and corresponding to its v_P, it obtains frequency of spin motion ω_P according to expression ($\mathrm{v}^2 = h\,\omega / m$), due to their respective $\mathrm{v_E}$ and v_P, the neutron obtains linear velocity $\mathrm{v_N}$ ($= \mathrm{v}_P$ - $\mathrm{v_E}$), and corresponding to its $\mathrm{v_N}$, it obtains frequency of spin motion ω_N, according to expression ($\mathrm{v}^2 = h\,\omega / m$). Further, as electron and proton both spin persistently, the neutron also spins persistently.

3 Explanation of properties of neutrons

The present neutron model provides all the properties to neutrons that they display. The properties of neutrons that have been included in this study are listed below:

3.1 Mean life time of about 15 minutes

Why and how neutrons survive for approximately 15 min (mean lifetime of neutron) before their decay, see Section 2.

3.2 Possession of both stable and unstable states

Why and how neutrons have both unstable and stable states, see Section 2.

3.3 Magnetic moment of neutron

According to the following existing expression for the spin magnetic moment (μ_S) of a spinning charged particle:

$$\mu_S = (q/2m)L_S \tag{1}$$

where q, m, and L_S, respectively, are the charge, mass, and spin angular momentum of the particle, the spin magnetic moment (μ_{SN}) of neutron should be = 0, because the neutron possesses charge (q) = 0. While on the contrary, the neutron has μ_{SN} = - 0.00966236×10^{-24} J/T. Currently, it is argued that neutron is not a charge less particle but has net charge = 0 and hence possesses μ_{SN} = - 0.00966236×10^{-24} J/T. It is true that neutron has net charge = 0, but in Eqn. (1), q is charge of the particle, and for neutron, q = 0, and hence, according to Eqn. (1), μ_{SN} should be = 0.

The net charge of neutron = 0, and μ_{SN} = finite, not = 0, means, neutron is a combination of two or more than two particles, each having charge, and μ_S, such that the resultants of their charge and μ_S give respectively q_N (charge of neutron) = 0, and μ_{SN} = - 0.00966236×10^{-24} J/T. But which are those particles?

The particles which constitute neutron are one electron and one proton (see Section 2). When they combining with each other constitute a neutron, the resultant of their charges = q_E (charge of electron = -e) + q_P (charge of proton = +e) gives the charge of neutron q_N (= 0), and the resultant of their spin magnetic moments = μ_{SE} (spin magnetic moment of electron = - $9.2847637\times10^{-24}\ J/T$) + μ_{SP} (spin magnetic moment of proton = 0.01410607×10^{-24} J/T) gives the spin magnetic moment of neutron μ_{SN} (= - 9.27065768×10^{-24} J/T). However, the experimental value of μ_{SN} = - 0.00966236×10^{-24} J/T. In neutron, because the directions of v_E and v_P lie in opposite directions, and the directions of μ_{SE} and μ_{SP} lie in directions opposite to the directions of v_E and v_P (see Section 3.1, 3.2, [1] for detail information), the directions of μ_{SE} and μ_{SP} lie in opposite directions. Therefore, the magnitude of μ_{SN} should be = μ_{SE} - μ_{SP} = ($9.2847637\times10^{-24}\ J/T$) – (0.01410607×10^{-24} J/T) = 9.2706576×10^{-24} J/T, and direction should be (-), i.e., μ_{SN} should be = - 9.2706576×10^{-24} J/T. It (theoretical μ_{SN}) has same sign as the experimental μ_{SN} (= - 0.00966236×10^{-24} J/T) has, but in magnitude, the theoretical μ_{SN} is much lesser (about 7×10^2 times) than the experimental μ_{SN} . The reason behind it may be 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} in magnitude. This decrease might be due to having about 2×10^3 times more mass by the proton in comparison to that of electron. Since neutron too is about 2×10^3 times more massive than electron, μ_{SN} is reduced by about 7×10^2 times in magnitude. This conclusion cannot be ruled out because, we find that, as m_N (mass of neutron = 1.6749×10^{-27} Kg) is very little $> m_P$ (mass of proton = 1.6726×10^{-27} Kg), μ_{SN} is very little $< \mu_{SP}$.

3.4 Electric dipole moment of neutron

When an electron combining with a proton constitute a neutron, as their balls of charge do not merge into a single ball but, due to spin motions of electric fields of their balls of charge in directions opposite to each other, a very fine space is left between their balls of charge (see Section 2), an electric dipole is created within the neutron. Consequently, neutron possesses electric dipole moment.

3.5 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 of same mass, same size, same substance, and spherical or cylindrical in shape. To one bullet, we give a conical shape at its head (i.e. front side). If these bullets are fired with the same energy on the same target from the same distance one by one, 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 same manner, as in neutron structure, because the electron lies always in front of proton during its (proton) motion (see Section 2), and electron is much lighter than the proton, the size of electron shall also be smaller than the size of proton, 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, because electrons and protons both possess motional energy (E_{ME} and E_{MP} respectively), and motional momentum (p_{ME} and p_{MP} respectively), therefore, neutrons possess motional energy E_{MN} $(= \mathrm{E}_{\mathrm{ME}} + \mathrm{E}_{\mathrm{MP}})$ and motional momentum p_{MN} $(= p_{ME} + p_{MP})$. Consequently, the neutrons possess high penetrating power.

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

After collision of electron with proton (see Section 2), during time t_1, due to continuous decrease in ω_{EC}, because the v_{EC}, which would have generated in the ball of charge of the electron due to ω_{EC} if the electron had not collided with proton and it (electron) had been free to move onwards, goes on decreasing continuously as ω_{EC} decreases, accordingly, the opposing force on the proton by the electron goes on decreasing continuously. As a result of this, the velocity v_P and energy E_P of proton, which had been reduced to v_P' and E_P' respectively after collision of electron with that (proton), go on increasing, but gradually. Consequently, the energy of neutron is found to be increasing continuously during time t_1, but gradually.

After v_{EC} becomes $= \mathrm{v}_{EM}$, $\mathrm{v}_{EM} - \mathrm{v}_{EC}$ starts increasing and the electron obtains tendency to move in the direction of v_{EM} (i.e., in the direction of motion of the proton), and after some time t_2, a stage comes, when $\mathrm{v}_{EM} - \mathrm{v}_{EC}$ is increased as much that it ($\mathrm{v}_{EM} - \mathrm{v}_{EC}$) may become greater than the velocity of proton (see Section 2). During time t_2, because the electron possesses tendency to move along the direction of motion of the proton, and it goes on increasing continuously as ω_{EC} decreases, the opposing force by the electron on the proton is now converted into supporting force during time t_1, As a result of this, the velocity v_P and energy E_P of proton, now start increasing rapidly. Consequently, the energy of neutron is found to be increasing rapidly during time t_2.

Therefore, during time t_1, as the energy of neutron is found to be increasing continuously but gradually, if we obtain several neutrons, containing neutrons of instants $t_1', t_1'', t_1''', t_1''''$, and so forth, their energy shall be found continuously increasing, but the increasing shall be gradual, and the range of their energy shall be low. Moreover, during time t_2, as the energy of neutron is found to be increasing continuously but rapidly, if we obtain several neutrons, containing neutrons of instants $t_2', t_2'', t_2''', t_2''''$, and so forth, their energy shall be found continuously increasing, but the increasing shall be rapid.

Therefore, as neutrons of instants $t_1', t_1'', t_1''', t_1''''$, and so forth are of gradual increasing energy range, and neutrons of instants $t_2', t_2'', t_2''', t_2''''$, and do forth are of rapid increasing energy range, there is found a distinguishable difference between their energy ranges.

3.7 Occurrence of neutrons always in moving state

How neutrons are found always in moving state, see Section 2.1, [1].

3.8 Possession of motional energy and motional momentum by neutrons

How neutrons possess motional energy and motional momentum, see Section 2.2, [1].

4 Importance of the present neutron model

The present neutron model provides very clear and complete explanations of:

1) all the properties generated due to nucleons in their systems: deuterons, alpha particles, and nuclei (see Sections 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6, [5]), including properties that could have never been explained before, for example:

i) how neutrons become stable in deuterons, alpha particles, and nuclei, and are bound together in them (see Sections 3.1.1, 3.2.1, 3.2.3, and 3.3.1, [5]);

ii) why and how only deuterons (NP) exist in nature, and di-proton (PP) and di-neutron (NN) do not exist while the existence of PP and NN is theoretically possible {see Sections 3.1.2, and 3.1.3, [5]);

iii) why and how tritium (^{3}H) decays into helium-3 (^{3}He) through beta decay, despite the E_b (binding energy per nucleon) of ^{3}H > the E_b of ^{3}He (see Section 3.2.6, [5]);

iv) why and how nucleons are bound in alpha particles so strongly such that they behave like particles (see Section 3.3, [5]);

v) how the E_b of the nucleus of beryllium (^{8}Be) < the E_b of the nucleus of helium (^{4}He), while the E_b of nuclei increases as their A increases by integer multiple of 4 {see bullet a) of Section 3.4.2, [5]};

vi) why and how for A > 200, the nuclei become radioactive {see bullet a) of Section 3.6.2, [5]};

vii) how alpha and beta particles are produced in radioactive nuclei, and how they are emitted from them {see bullet a) of Section 3.6.2, [5]};

viii) how beta particles, emitted from radioactive nuclei, have continuous energy spectrum {see bullet b) of Section 3.6.2, [5]};

2) structures of deuterons, alpha particles, and nuclei (see Sections 3.1, 3.2, 3.3, 3.4, and 3.5, [5]).

5 Discussion

The current neutron models fail to explain the properties listed above in Section 4. Second, the quark model, which is considered as a standard model, gives rise to numerous very serious fundamental questions (see Section 1). Third, the current neutron models fail to explain, except probably a few properties, all the properties generated in deuterons, alpha particles, and nuclei. Fourth, they fail to explain structures of deuterons, alpha particles, and nuclei.

6 Conclusion

As we know, properties of a person depend upon his physical and mental structures, and a work performed by him depends upon his properties. In the same manner, properties of neutrons should depend upon their structure; and all the phenomena, all the properties and structures of their systems, e.g., deuterons, alpha particles, and nuclei, generated due to them (neutrons), should depend upon their properties. Therefore, if a model of neutrons is developed, that model should explain their all the properties, and their properties should explain all the phenomena, all the properties and structures of their systems, generated due to them. Otherwise, the developed models of neutrons, e.g., the current neutron models, cannot be true. Consequently, there are: 1) several properties of neutrons that they display (see

Section 4); 2) numerous very important properties generated due to neutrons in their systems, e.g., deuterons, alpha particles, nuclei (see Sections 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6. [5]); and 3) structures of deuterons, alpha particles, nuclei (see Sections 3.1, 3.2, 3.3, 3.4, and 3.5, [5]); which were unexplained before the present neutron model.

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FIGURE CAPTION

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

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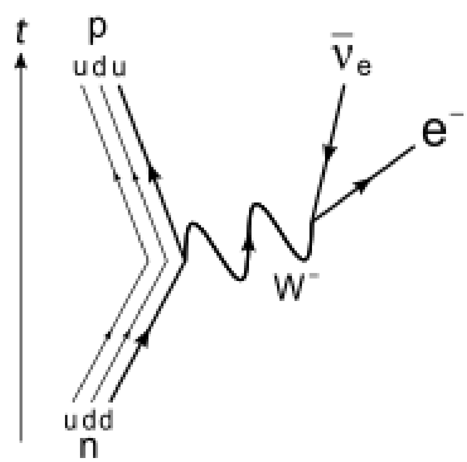

Fig. 1