WHY ELECTRONS AND NUCLEONS POSSESS PERSISTENT SPIN MOTION

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Because all electrons, nucleons, and other particles or quanta (because quantum mechanics is applied to all particles, these should be known as quanta) 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. At present, research on this topic attempts to determine how electrons, nucleons, and other particles possess a persistent spin motion through their unique structures as well as the purpose why they have such persistent spin motion. These determinations provide very clear and complete explanations of all the phenomena or events related to these particles as well as the structures and/or properties of their systems, for example, nuclei, their beams, and current-carrying specimen substances.

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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 special structure that keeps them persistently beating and hence provides all the properties that they display. Therefore, because all electrons, nucleons, and other particles or quanta (quantum mechanics is applied to all particles; thus, they should be known as quanta) 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 quanta should have a special structure that keeps them persistently spinning and provides 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 special 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 special structures, and their properties.

Therefore, the purpose why all electrons, nucleons, and other particles display a persistent spin motion (Section 2), their special structures, and their properties (Section 3) have been determined. These determinations provide us very clear and complete explanations of all the phenomena or events related to these particles (Section 4.1) and reveal additional knowledge regarding the structures and/or properties of their systems, for instance, the nuclei, their beams, and the current-carrying substances (Section 4.2).

Currently, electrons, nucleons, and other particles are assumed to possess wave characteristics, and all phenomena related to them are assumed to occur because of their dual nature (wave and particle characteristics). Their wave nature is assumed because this property alone and not the other quantum idea can account for the phenomena of interference and diffraction of electrons and photons. However, the concept of their wave nature cannot be considered to be true (see Section 1.1 of Ref. [1] for verification), and the interference and diffraction phenomena of electrons and photons cannot occur because of their wave nature (see Section 1.2 of Ref. [1] for verification).

2. DETERMINATION OF THE PURPOSE WHY ELECTRONS AND NUCLEONS POSSESS PERSISTENT SPIN MOTION

The spin motion of electrons, nucleons, and other spinning particles generate the following two properties.

2.1 First property

The spin motion of a spinning particle generates a tendency toward a linear motion along the direction of its spin angular momentum L_S (see Section I B of Ref. [2]). Therefore, because electrons, nucleons, and other particles possess a spin motion, they share a tendency of generating a linear motion along the directions of their respective L_S .

If the frequency of the spin motion of such particle is increased by some factors, a point will be reached when the particle starts moving along its L_S direction. If the frequency of the spin motion of the particle is increased further, the particle velocity continues to increase in accordance with the following equation [2]:

$$v^2 = h\omega / m \qquad (1)$$

where m, v, and ω are the mass, linear velocity, and frequency of the spin motion, respectively, of the particle, and h is the Planck's constant (for verification of the validity of Eq. (1), see Section I A, Ref. [2]).

Because all particles such as electrons, protons, and neutrons possess persistent spin motion, that (spin motion) keeps them to continuously move with linear velocity (v). Therefore, they are always found in a state of motion, which is oriented along the directions of their respective L_S (see Ref. [3] for verification), and their linear velocity (v) varies in the same manner as the frequency of their spin motion (ω) varies, as shown in Eq. (1).

2.2 Second property

Because a particle obtains kinetic energy (E_K) and linear momentum (p_{LIN}) due to its linear motion, it similarly acquires spin energy $E_S = h\omega/2$ (see Section II, Ref. [2]) and spin momentum $p_S = h\omega/v$ (see Section II, Ref. [2]) owing to its spin motion. (For verification that the particle acquires p_S due to its spin motion, see Section I C, Ref. [2].)

Therefore, electrons, nucleons, and all particles possess motional energy (E_M) = E_K + E_S and motional momentum (p_M) = p_{LIN} + p_S. During their motion, their E_M, p_M, and L_S are conserved but not their E_K and p_{LIN}. [To understand how E_M, p_M, and L_S of the electrons and nucleons are conserved, see Section 3.1. To verify that their p_M values are conserved, see Section I D, Ref. [2].] Because of the conservation of their E_M, p_M, and L_S, no violation of the laws arises with regard to the conservation of energy, momentum, and spin angular momentum during their motion under any condition. We present the following as examples.

1. During the motion of an accelerated electron by a large voltage (e.g., in Bertozzi's experiment [4]), when the rate of increase in its velocity starts decreasing (which causes a decrease in its E_K and p_{LIN}) after it attains relativistic velocity, the rate of increase in the frequency of its spin motion starts increasing, which in turn causes an increase in its E_S and p_S. The increase in E_S and p_S of the electron compensates the decrease in its E_K and p_{LIN}; thus, E_M and p_M of the electron are conserved. (For verification that after attaining relativistic velocity by the electron, its frequency of spin motion increases in order to conserve its E_M and p_M, see Sections IV C 1 and IV C 2, Ref. [2].) The increase in the rate of increase in the frequency of the spin motion of the electron occurs in such manner (Section 3.1) that the law of conservation of its L_S is not violated.

Currently, we believe that when the rate of increase in the electron velocity starts decreasing (which causes a decrease in its E_K and p_{LIN}) after attaining its relativistic velocity, its moving mass (m_{mov}) starts to increase to conserve its E_K and p_{LIN}. However, this cannot be true (for the justification, see Section 3.4.2, Ref. [5]). The equation for the moving mass of an electron $m_{mov} = m_e / \sqrt{(1 - \mathrm{v}^2 / c^2)}$ (where m_e is the rest mass of the electron and c is the velocity of light) is correct, but m_{mov} is not the moving mass of the electron. m_{mov} is actually the effective mass (m_{eff}) of the electron, which is obtained as a result of the superposition of the effect of the spin motion of the electron on its m_e. The relativistic kinetic energy $E_K =$ $[m_e c^2 / \sqrt{(1 - \mathrm{v}^2 / c^2)}] -$ $m_e c^2$ and relativistic linear momentum $p_{LIN} =$ $m_e \mathrm{v} / \sqrt{(1 - \mathrm{v}^2 / c^2)}$ of the electron are its E_M $(= m_{eff}\ \mathrm{v}^2/2)$ and p_M $(= m_{eff}\ \mathrm{v})$, respectively, which are obtained from the result of the superposition of the effects of E_S and p_S of the electron on its E_K (= $m\mathrm{v}^2/2$) and p_{LIN} $(= m\mathrm{v})$, respectively. (For further information on how these relationships are obtained, see Section IV C, Ref. [2]).

2. During the motion of the electron along its elliptical orbit, because the velocity of the electron varies, E_K and p_{LIN} of the electron also accordingly vary. Then, ω of the electron varies in such a manner that the variations caused on its E_S and p_S due to the variation in its ω, may balance the loss or gain that occurs in its and p_{LIN} due to the variation in its velocity. Thus, E_M and p_M of the electron remain conserved throughout its orbital motion. The variation in the frequency of the spin motion (ω) of the electron occurs in such manner (Section 3.1) that the law of conservation of its L_S is not violated.

Note: During the motion of the electrons along their elliptical orbits as well as during their motion after attaining relativistic velocity, variation between their v and ω does not occur according to Eq. (1) but rather occurs according to the following equation:

$$v^2 = h\omega / m_{eff} = h\omega / m_{mov} \tag{2}$$

3. DETERMINATION OF THE SPECIAL STRUCTURES OF ELECTRONS, PROTONS, AND NEUTRONS

3.1 Determination of the special structure of electrons

The current concepts regarding the structure of an electron, which is similar to a ball of electrical charge (–*e*), and its magnetic field, spin magnetic moment (μ_S), and other properties are obtained from the spin motion of its ball of charge are incorrect (for verification of its proof, see Section 1, Ref. [6]).

An electron has a special structure. It also possesses a degree of magnetism owing to its nature. In the same manner, an electron possesses a charge ($-e$). The magnetism occurs in the form of a circular ring, as shown by the dark solid-line circle around the charge of the electron, which (charge of the electron) has been shown by a spherical ball in Fig. 1(a), e.g., similar to the rings around planet Saturn. Surrounding the ball of charge of the electron is an electric field (not shown in Fig. 1), and around the ring of magnetism of the electron exists the magnetic field, which is shown by the circles with broken lines in Fig. 1(a). The ring of magnetism and the ball of charge of the electron both spin with frequencies ω_{EM} and ω_{EC}, respectively, but in opposite directions, as shown by the opposing arrows in Fig. 1(b); the ball of charge is represented by a thick dark circle, and the ring of magnetism is represented by a thinner dark circle.

The opposing spin motions of the ring of magnetism and ball of charge of the electron is a special characteristic caused by the special structure of electrons. Further, their fields interact (electromagnetic interaction) with each other in a manner that their spin motion persists (for further information, see Section 3.4).

When the ring of magnetism and ball of charge of the electron spin with frequencies ω_{EM} and ω_{EC}, respectively, due to their spin motion, linear velocities v_{EM} and v_{EC}, respectively, are generated along the directions of their respective spin angular momentum L_{SM} and L_{SC}, according to Eq. (1). Consequently, the electron acquires linear velocity v_E (= v_{EC} - v_{EM} or = v_{EM} - v_{EC}) along the L_S direction. Further, corresponding to velocity v_E, the frequency of the spin motion (ω_E), which is obtained from Eq. (1), can be assumed as the frequency of the spin motion of the electron. During the electron motion along its elliptical orbits or after attaining relativistic velocity, ω_E is obtained corresponding to its linear velocity v_E (= v_{EC} - v_{EM}) according to Eq. (2).

During the electron motion along its elliptical orbits or after attaining relativistic velocity when its v varies, (i.e., decreases or increases), it contracts or expands to conserve its E_M, p_M, and L_S. Subsequently, its radius (r) decreases or increases, which causes a consequential decrease or increase in its moment of inertia I (= $m_e r^2$). The decrease or increase in I of the electron causes a decrease or increase in L_S (= $I\, d\theta/dt$, where $d\theta/dt$ is the angular velocity of its spin motion) of the electron. Therefore, to conserve L_S of the electron, $d\theta/dt$ of the electron is increased or decreased, which causes an increase or decrease in ω of the electron according to Eq. (2). The increase or decrease in ω causes an increase or decrease in the electron E_S and p_S, which respectively conserves E_M and p_M by compensating the decrease or increase in its E_K and p_{LIN} caused due to the variations (decrease or increase) in its v. The expansion or contraction concept of the electron is considered difficult to believe, but it cannot be neglected. As the proton size shrinks, [7] the electron size can also shrink. Second, photons, which are bundles (quanta) of radiation energy and behave similar to particles (Section 2, Ref. [8]), are known to be emitted from the orbiting electrons. This condition can only be possible if during electrons excitation, they are filled with radiation energy and they expand. After their excitation, they suddenly contract (shrink), and by collectively emitting their contained radiation energy during their excitation in the form of photons, they transit back (for detailed information, see Section III B, Ref.

[2]). The number of times an orbiting electron expands and contracts during its one complete orbital motion along its elliptical orbit is equal to the number of photons emitted from that orbiting electron. The frequencies of the spin motion of the emitted photons (which are derived from the orbiting electron; see Section I A, Ref. [2] for its verification) and the levels of radiation energy that they contain depend on the different positions where the orbiting electron emits the photons during its orbital motion. These photons comprise a number of fine lines in the fine structure of the spectral lines, their (fine lines) frequencies, and their intensities, in accordance with the number of photons, their spin-motion frequencies, and the levels of radiation energy that they contain (for detailed information, see Section III, Ref. [2]).

When ω_{EC} and ω_{EM} of the electron generate v_{EC} in the ball of charge (due to its spin motion along the L_{SC} direction) and it (v_{EC}) is greater than the generated v_{EM} in the ring of magnetism (due to its spin motion along its L_{SM} direction) (i.e., $v_{EC} > v_{EM}$), the electron acquires v_E along the L_{SC} direction (i.e., L_S of the electron lies along the L_{SC} direction). When ω_{EC} and ω_{EM} of the electron generate v_{EC} in the ball of charge (due to its spin motion along its L_{SC} direction) and it (v_{EC}) is lesser than the generated v_{EM} in the ring of magnetism (due to its spin motion along its L_{SM} direction) (i.e., $v_{EC} < v_{EM}$), the electron acquires v_E along the L_{SM} direction (i.e., L_S of the electron lies along the L_{SM} direction). The first condition (i.e., the electron has its v_E along the L_{SC} direction) normally occurs. The second condition (i.e., the electron has its v_E along the L_{SM} direction) occurs very rarely and only under special circumstances (Section 2, Ref. [9]).

The spin magnetic moment (μ_S) of the electron is generated by the spin motion of its ring of magnetism and occurs along the L_{SM} direction. Because v_E normally occurs along the L_{SC} direction and L_{SC} occurs opposite the L_{SM} direction, v_E occurs opposite the μ_S direction.

3.2 Determination of the special structure of protons

A proton has the same amount of charge (+*e*) as the electron (–*e*); however, the proton is approximately 2×10^3 times more massive than the electron, which means that the proton possesses something more—probably, some materials—along with its charge (+*e*). Its charge and materials most likely exist together in the form of a ball, similar to that of the electron. (For convenience, we shall express the ball of charge and material as a ball of charge.)

The proton possesses all the properties similar to the electron. Therefore, the ball of charge and the ring of magnetism of the proton also spin with frequencies ω_{PM} and ω_{PC}, respectively, in directions opposite to each other. This is a special characteristic of the proton structure that keeps it persistently spinning.

The frequency of the spin motion of the proton is denoted as ω_P, and its linear velocity along the direction of its spin angular momentum (L_S) is denoted as v_P, similar to the electron frequency of the spin motion (ω_E) and linear velocity (v_E) along its L_S direction. μ_S of the proton is generated by the spin motion of its ring of magnetism and occurs along the L_{SM} direction.

Occurrence of proton linear velocity v_P along the L_{SM} direction does not happen to be possible because of the large mass of its ball of charge (approximately 2×10^3 times that of the ball of charge of the electron). Proton linear velocity v_P occurs only along the L_{SC} direction

3.3 Determination of the special structure of neutrons

A neutron is a combination of an electron and a proton, which (combination) happens to be such that the neutron behaves as a single particle in nuclei as well as outside the nuclei, similarly, as a proton behaves. This combination keeps neutrons persistently spinning and provides all the properties that the neutron displays. For detailed information, the readers are referred to Ref. [9].

3.4 Dextermination of how the special characteristic of electrons, protons, and neutrons caused by their special structures keeps them persistently spinning

Because the electrons and protons persistently spin without a source of infinite energy, their charge and magnetism remain intact and are not utilized during their spinning, which can only be possible if the balls of charge and the rings of magnetism of the electron and proton both spin in opposite directions. Because then the direction of the spin magnetic moment of the ring of magnetism (along the direction of its spin angular momentum) and that of the spin electric moment of the ball of charge (along the direction of its spin angular momentum) of the electron relative to the proton are opposite. Under this condition, the interaction between their fields occurs in such a manner that during their spin motion, no energy emanates from the electron [either electric (i.e., charge) or magnetic (i.e., magnetism)]. As we know, when the directions of the magnetic moment of two bar magnets are opposite to each other (i.e., when two bar magnets are placed one upon the other and parallel to each other with their opposite poles oriented opposite each other), interaction between their magnetic fields takes place such that their magnetism remain intact and does not decay. If the directions of the magnetic moment of two bar magnets are not opposite to each other (i.e., if the bar magnets are oriented in any other position), their magnetism does not remain intact. Instead, it starts to decay and vanishes after some time. Some doubts surround the electric moment of both the electron and proton because no evidence of its occurrence is available. Nevertheless, this concept cannot be ruled out.

For the explanation on how the special characteristic of neutrons caused by their special structures keeps them persistently spinning, see Section 2.1 of Ref. [9].

4. IMPORTANCE OF THE DETERMINED PURPOSE, SPECIAL STRUCTURES, AND SPECIAL CHARACTERISTICS

4.1 Importance of the determined purpose

The result of the determination of the purpose why electrons, nucleons, and all other particles possess persistent spin motions (Section 2, Ref. [5]) allows us to obtain a very clear and complete understanding of all the phenomena related to them. The following list shows some of the related important phenomena included in this study:

1) Interference and diffraction of photons and electrons (Section 3.1, Ref. [5]).

2) Spectroscopy (Section 3.2, Ref. [5]).

3) Transmittance *T*, which is finite for particles possessing energy $E < V_0$, where V_0 is the energy of the potential barrier (Section 3.3, Ref. [5]).

4) Reduction in the rate of increase in velocity of the accelerated electron after attaining its relativistic velocity (Section 3.4, Ref. [5]).

5-i) Acquisition of elliptical orbits by orbiting electrons despite moving in a spherically symmetric field (Section 3.5.1, Ref. [5]).

5-ii) Conservation of energy, momentum, and spin angular momentum of the orbiting electrons during their orbital motion along their elliptical orbits (Section 3.5.2, Ref. [5]).

4.2 Importance of the special structures of electrons and nucleons

The results of the determination of the special structures of electrons, protons, and neutrons and their electrical and magnetic field properties, together with the results of the determined purposes why they possess persistent spin motions (Section 2, Ref. [10]), provide us the following:

1) Determination of a new force with characteristics of nuclear force and both the attractive and repulsive components (Section 3.1, Ref. [10]).

2) Clear and complete explanation of all the phenomena, properties, and effects related to these particles generated in their systems, e.g., in their beams and electric current-carrying substances (Section 3.2, Ref. [10]), in their persistent current-carrying substances at the superconducting state (Section 3.3, Ref. [10]), in deuterons, alpha particles, and nuclei (Section 3.4, Ref. [10]).

3) Clear and complete understanding of the structures and properties of their systems, e.g., deuterons, alpha particles, and nuclei (Section 3.4, Ref. [10]).

4.3 Importance of the special characteristics of electrons and nucleons

The determination of the special characteristics of electrons and protons resulting from their special structures enable us to resolve a number of important and challenging problems such as the following:

1) Why and how neutrons survive for approximately 15 min (the mean lifetime of a neutron) before decaying, whereas the rest of the unstable elementary particles decay within a fraction of a second (Section 2, Ref. [9]).

2) Why and how neutrons have both unstable and stable states while the rest of the elementary particles have only one state, which is either stable or unstable (Section 2, Ref. 9).

3) How neutrons become stable in their systems, e.g., deuterons, alpha particles, and nuclei (Section 2, Ref. [9]), whereas they are unstable in their free state.

4) How neutrons possess a magnetic moment, which is equal to $-0.00966236\times10^{-24}$ J/T (Section 3.1, Ref. [9]).

5) Why and how electrons are emitted from the nuclei during the β decay despite the assumption that electrons do not reside inside a nucleus (Section 3.3, Ref. [9]).

6) Why and how the energy of the emitted β particles varies in the form of a continuous energy spectrum (Section 3.4, Ref. [9]).

7) Why and how neutrons have a high penetration power and distinguishable low- and high-energy ranges (Sections 3.5 and 3.6, Ref. [9]).

8) How positrons are produced, and why they are not found as electrons in nature (e.g., in substances). (Complete information shall be provided in my next manuscript.)

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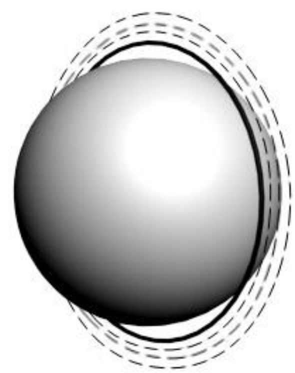
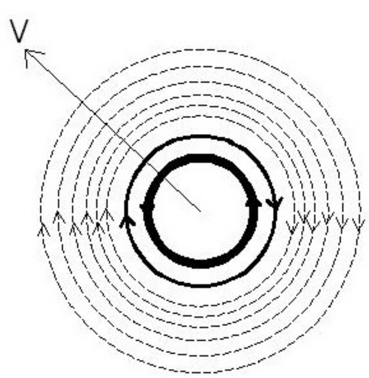
FIGURE CAPTIONS

Fig. 1: (a) Spherical ball, dark, solid line circle, and concentric broken line circles represent respectively the charge, magnetism, and magnetic field of an electron. (b) Transverse cross-sectional view of an electron where the ball of charge is indicated by a dark, thick, and solid-line circle, magnetism by a dark, thin, and solid-line circle, and magnetic field by broken-line circles with arrows to show the directions of their spin motion.



(a)



(b)

Fig. 1