THEORY WHICH EXPLAINS SEVERAL GREATLY IMPORTANT MYSTERIOUS PHENOMENA AND IT DETERMINES A NEW FORCE HAVING CHARACTERISTICS OF NUCLEAR FORCE

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When an electric current flows through any conducting rod: 1- Why (i.e. cause) and how (i.e. way) is a magnetic field generated around the rod? 2- Why and how does this field occur in a plane perpendicular to the direction of flow of current and possesses direction? 3- How and which type of magnetism (electromagnetism) is generated? How do electrons move together in electron beams in spite of having repulsive Coulomb force? Why and how does the Lorentz force come into play? No explanation is found how (i.e. way, or can say procedure) these phenomena take place. Electromagnetic theory has wide success to its credit but it and other theories fail to do so, which is their great drawback. Because, as we know, whenever any phenomenon takes place, there occurs always a way how that phenomenon takes place, and hence the theory, given in order to explain that phenomenon, must explain how that phenomenon takes place. Electromagnetic and other theories fail because there are some causes behind the occurrence of these phenomena but no account of those causes have been taken into consideration. The causes are, e.g.: 1- The electron possesses magnetism by virtue of nature similarly as it possesses charge by virtue of nature, and it (magnetism) occurs in the form of a ring around the charge of electron, 2- The magnetism of the electron spins similarly as it's charge spins but in opposite directions, 3- The interaction between magnetic fields of interacting particles (e.g. between magnetic fields of electrons in electron beams) or interacting systems give rise to a force between them. In order to verify/justify the truth of the above causes, plausible argument and evidence has been provided from the well-established existing knowledge. Presently, taking into account the above causes, a new theory has been propounded which gives a very clear and complete explanation of all the above phenomena. The force caused due to interaction between magnetic fields of electrons has some very important and striking properties: this force is strong, short range and charge independent. Since the nature of this force is exactly similar to what we speculate for nuclear force between nucleons, and nucleons possess a magnetic field too, the nuclear force should be due to interaction between magnetic fields of nucleons in nuclei. Most importantly, this force has a repulsive component too, which is very essential to cause, e.g. alpha and beta decays etc. because the Coulomb repulsive force is too weak and hence cannot cause these decays. How this force varies, that has been determined. This force solves a greatly important mystery why and how near the mass number A = 62, the binding energy per nucleon is maximum (nearly 8.8 MeV) and then it gradually decreases as A increases. It confirms the truth of the determined force. Finally: i- effects of the present theory on some important current concepts and their consequences have been discussed; and ii- some possible new effects have been predicted and explained why and how they shall take place.

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1. INTRODUCTION

According to the existing concept, the magnetic moment possessed by the electron is acquired due to the spin motion of its charge. This concept has been derived [1] from a simple model in which an electron moves in a circular orbit in an atom. The magnetic dipole moment μ of this current loop is expressed as,

$$\mu = i A \quad (1.1)$$

where i is the effective current associated with the circulation of the electron and A is the area enclosed by the orbit. The expression (1.1) gives [1],

$$\mu_l = (-e/2m) L_l \quad (1.2)$$

where *-e* is the electron charge rotating in the loop, *m* is its mass, L_l (= *m v r*, where *r* is the radius of the orbit and *v* is the tangential speed of the electron) is its orbital angular momentum about the axis of its rotation and μ_l is its orbital magnetic dipole moment.

But expression (1.2) was not sufficient [1] to explain the observed properties; e.g. the fine structure of spectral lines etc., hence another kind of magnetic moment for the electron, called the intrinsic magnetic moment [1] μ_s was introduced. With this intrinsic magnetic moment, an intrinsic angular momentum L_s was associated by analogy with the expression (1.2). The relationship between μ_s and L_s is given as

$$\mu_s = (-e/2m) L_s \quad (1.3)$$

It is convenient to picture the intrinsic magnetic moment by considering the electron to be a ball of charge, spinning on its axis. Hence the μ_s and L_s respectively are also known as spin magnetic moment and spin angular momentum of electron.

The electron spins; it is true (for its confirmation, see reference-2, and Stern and Gerlach's experiment [3] also confirms it). But the concept that μ_l and μ_s are created respectively due to orbital and spin motions of the charge of electron is not true because it gives rise to several questions for which no answer can be given. For example:

1. Can the charge of electron create μ_l, μ_s and two magnetic fields (1st - around the electron due to its spin motion, and 2nd - around its orbital path due to its orbital motion) simultaneously due its two types of motions?

2. Supposing the two fields are created simultaneously, then during orbital motion of the electron, the 1st magnetic field (created around the electron due to spin motion of its charge) shall continuously pass through the 2nd magnetic field (created around the orbital path due to orbital motion of the charge of electron). Can it so happen? No, because then at every instant during orbital motion of the electron, there shall simultaneously occur two magnetic fields around the electron, which cannot be possible. Secondly, if the 1st magnetic field passes through the 2nd magnetic field during the orbital motion of electron, the lines of force of 1st magnetic field shall intersect the lines of force of 2nd magnetic field, which cannot take place because a magnetic line of force neither intersects itself nor other lines of force. Suppose if their intersection is somehow denied, but the interaction between them can neither be denied nor can it be overruled because:

i. The magnetic field around a current carrying solenoid is obtained due to interaction between magnetic fields created around each turn of the solenoid [see Fig. 17 of reference-4];

ii. When a bar magnet is placed in magnetic meridian of earth's magnetic field, their fields interact, Fig. 3;

iii. When a bar magnet is horizontally suspended freely on a hanger in earth's magnetic field, that bar magnet is aligned with its length parallel to the direction of earth's magnetic field due to interaction between their fields;

iv. When two bar magnets are placed close to each other, they are attracted/repelled by each other. This happens due to interaction between their magnetic fields.

What happens when the interaction between the 1st and 2nd magnetic fields takes place during orbital motion of the electron?

There are similarly several questions, to which the above concept of creation of magnetic fields due to the spin and orbital motions of the charge of electron give rise (see section-3.4.3). These questions raise serious question mark over the truth of the above concept.

The electron cannot have an intrinsic magnetic moment and a magnetic field unless it has magnetism, just like a bar magnet cannot have a magnetic moment and a magnetic field unless it has magnetism. And magnetism cannot be assumed generated through such ways, i.e. by spin motion and orbital motion of the charge of electron. The magnetism of the electron is analogous to the charge of electron, and as a charge cannot be assumed to be generated by means of spin motion and orbital motion of a point particle type of magnet, similarly magnetism cannot be assumed generated by means of spin motion and orbital motion of a point particle type of charge (e.g. electron).

If it is assumed that the charge of electron is radiated in the form of energy during its (electron) spin motion and that radiated energy is stored with it converting into magnetism, then of course the generation of magnetism due to the spin motion of the electron can be assumed. But, is it possible? No, because then, after some time, there shall be left no charge with the electron which practically cannot be possible. It too is not possible that during the spin motion of the electron, the continuous change of charge of electron into its magnetism and then change of that magnetism into its charge and so on goes on continuously.

Further and most importantly, how and from where does the electron obtain (or derive) energy for its continuous spin motion? Has electron some reservoir of infinite energy? No. Then there must exist positively some cause with the electron due to which its spin motion goes on continuously. What is that cause? (For that cause, see section-2.)

In addition to the above points of objection, the deduction of expression (1.3) gives rise to several questions. For example, during the orbital motion of electron, since the charge of electron moves along the orbit, the flow of current along the orbit is created and hence the application of expression (1.1) in deducing the expression (1.2) is justified. But, during the spin motion of electron, there occurs no flow of charge. And hence the deduction of expression (1.3) by analogy with the expression (1.2) is not true? If it is argued that during spin motion of charge, since the charge rotates about it's axis, the flow of charge around its axis of rotation can be assumed, and hence the deduction of expression (1.3) by analogy with the expression (1.2) is true, but then there must occur flow of some electric current around the axis of rotation of the charge. Does there occur any electric current? No. Therefore, the above argument is ruled out.

The above question raised by the deduction of the expression (1.3), force to conclude that the concept of occurrence of magnetic field and magnetic moment with electrons due to the spin motion of its charge is not true.

2. THEORY

The electron possesses magnetism by virtue of nature similarly as it possesses its charge e by virtue of nature. This magnetism gives rise to μ_s and magnetic field, which the electron possesses.

In order to justify the truth of the concept that the electrons possess magnetism by virtue of nature, let us discuss the proton. The proton possesses the same amount of charge (i.e. +*e*) as the electrons possess, but the proton possesses mass [5] $m_p = 1.67\times10^{-27}$ Kg while the electron possesses mass [5] $m_e = 9.11\times10^{-31}$ Kg, It means that their charge is not the only contribute to their mass. There occurs something more, other than their charge, which contributes to their mass, and its amount in a proton happens to be greater in comparison to that which occurs with electron. If we investigate, we find that the electron and proton both possess μ_s but its magnitude differs [5] in both the cases. The difference in magnitude of μ_s justifies the truth of occurrence of magnetism with electron by virtue of nature.

This magnetism occurs in the form of a circular ring, shown by a dark solid line circle, Fig. 1, around the charge of electron, where charge has been shown by a spherical ball, Fig. 1(a), and by a thick dark circle, Fig. 1(b). As, for an example, there occur rings around the planet Saturn. The magnetism (occurring in the form of a ring) and charge of electron, both spin, but in directions opposite to each other, shown by arrows in opposite directions, Fig. 1(b). The magnetic moment (μ_s), which the electron possesses, arises due to the spin motion of this magnetism, and occurs in the direction of spin angular momentum of this magnetism. Around this magnetism of the electron, there occurs a magnetic field in the form of a band of sets of concentric magnetic lines of force all along its (magnetic ring) width, Fig.1, [as, for example, there occurs magnetic field around a current carrying rod of very small length (like a chip) in the form of a band of sets of concentric magnetic lines of force all along its length] and this magnetic field spins along with the magnetic ring in the same direction.

The frequencies of the spin motion of charge and magnetism of electron happen to be such that the spin angular momentum of charge of electron, say L_{sc}, is greater than the spin angular momentum of magnetism of electron, say L_{sm}. The spin angular momentum L_s, which the electron (as a whole) possesses, happens to be the resultant of these two, i.e. $\boldsymbol{L_s = L_{sc} - L_{sm}}$. Consequently the electron possesses its linear motion in the direction of spin angular momentum of its charge, i.e. in the direction of L_{sc} (because the electron always moves in the direction of its spin angular momentum - see reference 2). The frequency, say ω, corresponding to resultant spin angular momentum L_s of electron, happens to be the actual frequency, which the electron possesses (see reference- 2).

The truth of the above concepts cannot be denied or overruled because:

1. We know that the electron possesses a magnetic moment, and magnetic moment possesses direction. It can be possible only if the magnetism of the electron spins, because then there shall arise its spin angular momentum, which possesses direction, and the magnetic moment can occur in that direction. Otherwise, there is no way by means of which the magnetic moment of the electron can possess direction. Because the magnetic moment of the electron lies in the direction opposite to the direction of it's L_s (or L_{sc}), the magnetism of electron must spin in the direction opposite to the direction of spin motion of the charge of electron.

2. Since the electron possesses charge and magnetism both, it is obvious that their fields shall interact (electromagnetic interaction). Because the charge and magnetism of the electron live together and they are not repelled by each other therefore the interaction between their fields must be attractive. The attractive type of interaction between them can occur only if the charge and magnetism of the electron spin in directions opposite to each other such that magnetic and electric moments of electron lie in directions opposite to each other. Because, it is observed that

when two bar magnets are placed parallel to each other with their magnetic moments in directions opposite to each other, the interaction between their magnetic fields happens to be attractive. Further to this, it is also observed that, in order that the magnetism (i.e. magnetic energy) of bar magnets does not vanish, the bar magnets are kept in pair and in contact and parallel to each other such that their magnetic moments lie in directions opposite to each other, which means, during interaction between their magnetic fields under such situation, their magnetism remains intact with them and no magnetic energy is radiated from them. Similarly, during continuous spin motion of electron, since no energy (magnetic or electric) is radiated from it (because, otherwise spin motion of electron cannot go on continuously), the charge and magnetism of electrons should spin in directions opposite to each other so that magnetic and electric moments of electrons lie in directions opposite to each other. Supposing some people do not agree with these arguments and express doubt, the question arises, then how do the electrons go on spinning continuously? We know, the electrons neither have any source of infinite energy nor do they receive any energy from outside for their continuous spin motion, but they go on spinning continuously. It means that there occurs positively some cause with them, which keeps them going on spinning continuously. That cause can be the spin motion of charge and magnetism of the electron in directions opposite to each other, because other than this, there is nothing else, which we can identify as responsible for their continuous spin motion.

3. The concept of spin motion of charge and magnetism of the electron in directions opposite to each other is very important because it gives a clear and complete explanation of several important mysteries, e.g.: i- why a neutron happens to be unstable in its free state, and why and how it becomes stable in stable nuclei and systems (deuterons and α particles); ii- why and how neutron decays always after about 15 minutes (mean life time of neutron), not earlier;

iii- why and how during β decay, electrons are emitted from the nuclei while it is firmly believed that electrons do not reside inside the nuclei; iv- how the energy of the emitted β particles is obtained in the form of a continuous energy spectrum; v- why and how neutrons obtained from disintegration have high penetrating power, and distinguishable low and high energy ranges etc. The above concept gives a very clear and complete explanation of several more greatly important mysterious phenomena: 1- why nature has provided us only deuteron, while the systems, di-proton and di-neutron are also theoretically possible but do not exist; 2- how two-neutrons and two-protons are arranged in an alpha particle such that it persists and behaves like a particle, and why and how its binding energy per nucleon (E_b) is increased to > $6\times E_b$ of deuteron; 3- why and how nuclei with mass number (A) integer multiple of 4, are most stable; 4- why and how E_b of the nucleus of $Be^8 < E_b$ of the nucleus of He^4 while E_b of nuclei goes on increasing as their A increases by integer multiple of 4; and 5- why and how near A = 62, E_b is maximum (nearly 8.8 MeV) and then it gradually decreases as A increases and ultimately for A > 200, the nuclei become radioactive. [A clear and complete explanation why and how all these mysterious phenomena/events take place shall be submitted for publication very shortly. Presently to give explanation of these phenomena is beyond the scope of this paper.]

3. EXPLANATION OF PHENOMENA

3.1 EXPLANATION OF HOW AND WHY THE LORENTZ FORCE COMES INTO PLAY ON AN ELECTRON WHEN IT MOVES AT AN ANGLE TO THE DIRECTION OF AN EXTERNAL MAGNETIC FIELD, AND WHY OTHERWISE THAT DOES NOT COME INTO PLAY

3.1.1 How the Lorentz force comes into play on an electron when it moves at an angle to the direction of external magnetic field

In order to express the Lorentz force on an electron having charge –e and moving with velocity v in an external magnetic field B perpendicular to its direction, an expression [6]

$$\mathbf{F} = - e\, \mathbf{v} \times \mathbf{B} \qquad (3.1)$$

has been formulated empirically. But no explanation has been found anywhere of how and why this force comes into play, how and why it acts along the thumb (according to Fleming left hand rule), how and why it does not come into play when the electron is moving parallel to the direction of external magnetic field. All these phenomena exist; we must have clear and complete knowledge of how and why these take place.

The inability of existing theories to explain the Lorentz force may be because nobody has tried to find it out. The cause of the Lorentz force is the interaction between the magnetic field of the electron and the external magnetic field in which the electron moves. It is quite amazing that despite knowing that the electron possesses a magnetic field, nobody probably ever tried to think over the interaction between the magnetic field of the electron and the external magnetic field.

However, let us see how interaction between the magnetic field of the electron and the external magnetic field acts as the cause and creates a situation under which the Lorentz force comes into play on the electron when it is moving perpendicular to the direction of external magnetic field.

The electron possesses direction of its linear motion in the direction of its L_s (see reference-2) and hence when the electron moves, the direction of its L_s is oriented and aligned in the direction of its motion. The electron's μ_s lies in the direction opposite to the direction of it's L_s; μ_s of electron lies in the direction opposite to the direction of motion of the electron. Then the planes of its magnetism (occurring in the form of magnetic ring) and magnetic field are obviously aligned in the plane perpendicular to the direction of its L_s, i.e. perpendicular to the direction of its motion.

Therefore, when some external magnetic field B is applied across the electron moving with velocity v, in direction perpendicular to the direction of it's v; the plane of magnetic field of electron lies in the plane parallel to the direction of external magnetic field B, Fig. 2(a). Under this situation, when the lines of force of the magnetic field of the electron interact with the lines of force of external magnetic field B, some lines of force of external magnetic field (e.g. 5 and 6) are pushed aside while some of them (e.g. 1, 2, 3 and 4) are dragged along with the lines of force (e_3, e_4, e_5) of magnetic field of electron, as shown in Fig. 2(a) [because, according to property of magnetic lines of force, the magnetic line of force neither intersects itself nor other magnetic lines of force], similarly as some lines of force of earth's magnetic field (e.g. 1, 2 above and 9, 10 below the magnetic axis of the bar magnet, Fig. 3) are pushed aside while some (e.g. 3, 4, 5 above and 6, 7, 8 below the magnetic axis of the bar magnet, Fig. 3) are dragged along with the lines of force (m_3, m_4, m_5) of the bar magnet and go into the bar magnet through its south pole when the bar magnet is placed in magnetic meridian of earth's magnetic field with its south pole towards the geographical south pole of earth and north pole towards the geographical north pole of earth, Fig. 3.

Near point P, Fig. 2(a), the pushed aside lines of force 5 and 6 of external magnetic field are repelled by lines of force e_2 and e_1 respectively of magnetic field of electron due to their mutual interaction, because near point P they are in directions just opposite to each other. Consequently some neutral space has been created (i.e. space free from magnetic effects of magnetic field of electron and external magnetic field) around point P, similarly as neutral space around P is created above the magnetic axis of the bar magnet, Fig. 3, due to repulsion of magnetic lines of force 1, 2 of earth's magnetic field by lines of force m_1, m_2 of the bar magnet, and neutral space around P' is created below the magnetic axis of the bar magnet due to repulsion of magnetic lines of force of magnetic lines of force 10, 9 of earth's magnetic field by lines of force m_1, m_2 of the bar magnet.

The lines of force 1,2,3 and 4 of external magnetic field B are dragged along with the lines of force e_3, e_4, e_5 of magnetic field of electron, they (1,2,3 and 4 of external magnetic field) are pushed behind the electron, as shown in Fig 2(a). But in the process of pushing behind, the lines of force 1,2,3 and 4 of external magnetic field are expanded. They try to acquire their original form, because according to properties of magnetic lines of force, they are just like flexible strings and experience the longitudinal tension in its length. For example, as shown in Fig. 3, the lines of force 3,4,5 and 6,7,8 of earth's magnetic field acquire their original form after coming out from the north pole of the bar magnet, which implies, the magnetic lines of force possess tendency to acquire their original form. Therefore, in order to acquire their original form, the lines of force 1,2,3 and 4 of external magnetic field apply some pushing force on magnetic lines of force e_3, e_4, e_5 of electron, which in turn apply pushing force on the electron. Consequently a force F is observed, acting on the electron downward, Fig. 2(a). If we examine the direction of this force F with respect to the direction of external magnetic field B and the direction of motion of electron, i.e. v, Fig. 2(b), we find it to be in accordance with the Lorentz force.

As the consequence of downwards pushing force (i.e. Lorentz force) on the electron, Fig. 2(a), when it goes downwards, the lines of force 7 and then 8 [not shown in Fig. 2(a)] and so on of external magnetic field successively interact with the lines of force of electron in the same fashion and in this way the electron goes on moving in the direction of the Lorentz force.

Here, it is possible that some people may argue, when the bar magnet is placed in the magnetic meridian of earth's magnetic field, Fig. 3, there too are obtained neutral regions (P and P') and some lines of force of earth's magnetic field (3,4,5 and 6,7,8) go into the bar magnet along with it's lines of force after their repulsion, and in this process they are expanded, but no force is observed on it either upwards (i.e. towards neutral region P) or downwards (i.e. towards neutral region P'). The reason behind it is that the lines of force 3,4,5 of earth's magnetic field try to push the bar magnet upwards while the lines of force 6,7,8 try to push it downwards. No resultant force is observed on the bar magnet in any direction.

3.1.2 Why does the Lorentz force not exist when the electrons move parallel to the direction of external magnetic field

When the electron moves parallel to the direction of the external magnetic field, the direction of its L_s lies parallel to the direction of external magnetic field B. Consequently the plane of its magnetic field lies in a plane perpendicular to the direction of the external magnetic field. In this situation, the lines of force of the magnetic field of the electron do not interact with the lines of force of the external magnetic field in the way they interact when the electron moves perpendicular to the direction of external magnetic field. For interaction between them, as shown in Fig. 2(a), it is essential that the plane of magnetic field of electron must have a component in the plane parallel to the direction of the external magnetic field. Hence, in the present situation, no neutral space is obtained [as it is obtained in previous situation, Fig. 2(a)], and the lines of force of the external magnetic field are not dragged along with the lines of force of the magnetic field of the electron and are not pushed behind the electron so they can apply a pushing force on the electron towards the neutral space. Hence no pushing force on the electron is observed; consequently the Lorentz force does not come into play.

In the present situation, since the plane of the magnetic field of the electron lies in the plane perpendicular to the direction of the external magnetic field, the charge and the magnetic field of the electrons block the paths of lines of force of the external magnetic field, which were earlier passing through the area (in the plane perpendicular to the direction of external magnetic field) when the electron was not there and now that area has been occupied by the charge and magnetic field of the electron, and do not allow them to pass through that area. Because to pass through that area, those lines of force will have to intersect the lines of force of the magnetic field of electron, which they cannot do. Hence, those lines of force of external magnetic field are deviated from their respective paths and reach opposite side (i.e. backward side) of the electron turning round the circular end of its magnetic field, as shown in Fig. 4.

3.2 EXPLANATION OF HOW ELECTRONS IN ELECTRON BEAMS MOVE TOGETHER IN SPITE OF HAVING REPULSIVE COULOMB FORCE BETWEEN THEM

Because of repulsive Coulomb interaction between the electrons, the electrons should not move together in electrons beams. But on the contrary, in electron beams, e.g. in cathode ray oscilloscope (C.R.O.), the electrons move together. Further, we observe that when the electron beam is deflected vertically upward ↑ downward ↓ or horizontally left ↔ right in C.R.O. applying electrostatic field across horizontal or vertical pair of plates, none of the electrons go out from the beam but all the electrons remain intact in the beam. It means, in the electron beam, there comes into play positively some force of attraction between the electrons, stronger than the Coulomb repulsive force, and keeps the electrons bound together in the beam against the Coulomb repulsive force. But the question arises, how (i.e. way) and from where does this force of attraction between electrons come into play?

We know that electrons possess a magnetic field too. If due to interaction between charges of electrons a force, i.e. Coulomb force comes into play between them, similarly, due to interaction between the magnetic fields of electrons, some force must come into play between them. The interaction between magnetic fields of electrons and hence coming into play a force between them cannot be contradicted or overruled because: i- magnetic field around a current carrying solenoid is obtained due to interaction between magnetic fields created around each turn of the solenoid (see Fig. 17 of reference-4); ii- when a bar magnet is placed in magnetic meridian of earth's magnetic field, their fields interact, Fig. 3; iii- when a bar magnet is horizontally suspended freely on a hanger in earth's magnetic field, that bar magnet is aligned with its length parallel to the direction of earth's magnetic field due to interaction between their fields; and iv- when two bar magnets are placed parallel and close to each other, they are attracted/repelled by each other, that happens due to interaction between their magnetic fields..

Let us now try to determine how a force comes into play between the electrons of the beam due to interaction between their magnetic fields, and how that force happens to be attractive.

The electron possesses direction of its linear motion in the direction of its L_s (see reference-2) and hence when it moves, the direction of it's L_s is oriented and aligned in the direction of its motion. Consequently the directions of L_s of all the electrons of the electron beam are oriented and aligned in the direction of motion of the beam moving with velocity, say v. And the planes of magnetism and magnetic field of all the electrons are aligned in the plane perpendicular to the direction of motion of the beam.

Let us consider two electrons, say A and B, of the beam, which are adjacent to each other and lying in the same transverse plane of the beam, as shown in Fig. 5(a). The planes of their magnetic fields shall lie in the same plane. Let r be the radii of the outermost concentric circular lines of force of magnetic fields of the electrons. If the distance, say d, between their centers becomes $< 2r$, their lines of force start interacting, as shown in Fig. 5(b). Let the distance d between their centers be such that the outermost two lines of force a_1 and a_2 of electron A interact with the outermost two lines of force b_1 and b_2 of electron B. In the region of their interaction (i.e. in between the electrons A and B), the directions of lines of force a_1 and a_2 of electron A are opposite to the directions of lines of force b_1 and b_2 of electron B, Fig. 5(b). They repel each other in this configuration. Consequently the lines of force a_1, a_2 of the electron A, after their repulsion, are diverted towards the electron B and dragged along with its lines of force b_3, b_4 etc. and pushed behind the electron B, as shown in Fig. 5(b). And the lines of force b_1, b_2 of the electron B, after their repulsion, are diverted towards the electron A and dragged along with its lines of force a_3, a_4 etc. and pushed behind the electron A. Finally the lines of force a_1, a_2 of electron A and b_1, b_2 of electrons B acquire the form, as shown in Fig. 5(b), and around point P a neutral region is created (i.e. region free from the effects of magnetic fields of electrons A and B). In the process of getting pushed behind, the lines of force a_1, a_2 and b_1, b_2 are expanded, and hence in order to obtain their original positions and form (i.e. shape) as they had before their interaction, they apply some pushing force on magnetic lines of force b_3, b_4 and a_3, a_4 respectively, which in turn apply pushing force on electrons B and A respectively. Because, according to properties of magnetic lines of force, the magnetic lines of force are just like flexible strings and experience the longitudinal tension in its length, hence possess tendency to acquire their original form. In order to verify its truth, we can see Fig. 3, where the lines of force 3,4,5 and 6,7,8 of earth's magnetic field acquire their original positions and form after coming out from the north pole of the bar magnet. Consequently the electrons A and B are pushed towards each other, which appears in the form of attraction between them.

If we take, as an example, eight electrons, Fig. 6(a), or nine electrons, Fig. 6(b), or seven electrons, Fig. 6(c), adjacent to each other and lying in the same transverse plane of the beam, their lines of force, as the consequence of their mutual interaction, acquire the forms as shown in Figs. 6(a), 6(b) and 6(c) respectively. In similar fashion, the lines of force of all the electrons, lying in different transverse layers of the beam acquire the forms as shown in Figs. 7(a, b, c_1 and c_2) as the consequence of their mutual interaction. And in this way, finally a magnetic field is obtained around and along the length of the beam in coaxial hollow cylindrical form, as shown in Fig. 7(c_2) [if the beam is having circular transverse cross-section, Fig. 7(c_1)].

Due to this magnetic field, produced around and along the length of the beam, the beam is deflected according to the *Fleming left hand rule* when passed through some external magnetic field perpendicular to its direction. Because, when the beam is passed through the external magnetic field perpendicular to its direction, the magnetic field produced around the length of the beam and external magnetic field interact, similarly as the magnetic field around the electron and the external magnetic field interact and the electron is deflected [see section-3.1.1 and Fig. 2] according to the *Fleming left hand rule* when it moves perpendicular to the direction of external magnetic field.

3.2.1 Explanation of how and when the force, which comes into play due to interaction between magnetic fields of electrons, becomes repulsive

The force which comes into play due to interaction between magnetic fields of electrons, can be attractive or repulsive. Let us now see how and under what condition it happens to be repulsive.

Let us consider two electrons, say A and B, moving with velocity *v* parallel to each other but opposite in direction. At some point they are supposed to be adjacent to each other and lying in the same plane, Fig 8(a). In this situation, the planes of their magnetic fields shall lie in the same plane but the directions of spin motion of their magnetic fields shall be opposite, as shown in Fig 8(a). If the distance *d* between their centers happens to be < 2r, their lines of force start interacting, Fig 8(b). Let the distance *d* between their centers be such that the two outermost lines of force a_1 and a_2 of electron A interact with the two outermost lines of force b_1 and b_2 of electron B, Fig 8(b).

In this situation, in the region of interaction between their magnetic fields (i.e. in region between the electrons A and B) their lines of force a_1, a_2 and b_1, b_2 are not repelled by each other but are dragged along with the lines of force of each other, as shown in Fig 8(b). Because in this case, when their lines of force come close to each other, they are found moving along the same direction, whereas for their repulsion it is essential that they must be in opposite directions [as occurs in previous case, Fig. 5(b)]. Hence, when their lines of force are dragged along with the lines of force of each other (i.e. a_1, a_2 of electron A are dragged along with b_1, b_2 of electron B) and pass through the space between a_3 and b_3 lines of force of magnetic fields of electrons A and B respectively, they come very close to each other [for convenience, they have been shown overlapping in Fig. 8(b), while actually they do not overlap], because the space left between the lines of force a_3 and b_3 for them to pass through happens to be very narrow, as appears from the Fig 8(b). But, due to their properties (mentioned earlier), they do not want to pass through this space coming very close to each other but want to pass through maintaining their original positions and shape as they had before their interaction. Therefore, in order to pass through, maintaining their original positions and shape, the lines of force a_1, a_2 apply some pushing force on lines of force a_3, a_4 etc., which in turn apply pushing force on electron A towards our left; and the lines of force b_1, b_2 apply some pushing force on lines of force b_3, b_4 etc., which in turn apply pushing force on electron B towards our right. Consequently, the force of repulsion between the electrons A and B is observed

Thus two electrons, moving parallel to each other but in opposite directions, such that the distance d between their centers $< 2r$, are acted upon by a repulsive force.

Since the two electrons, moving parallel to each other but opposite in directions, come close to each other for a very short time (depending on their velocities), they receive a sudden kick type of repulsive force from each other.

3.2.2 How the force between the interacting electrons varies as the distance between them varies

i. When the electrons are in position as shown in Fig. 5(b)

The force caused due to interaction between the electrons A and B, when they are in position as shown in Fig 5(b), varies as

$$F \propto (M - e)^2 d^{-q} \quad \ldots\ldots \quad (3.2)$$

where M and e are respectively the amounts of magnetism and charge of electron, d is the distance between the centers of electrons A and B, $q = a d^b$, and a and b are the constants, which depend upon the velocities of electrons A and B and on how many their lines of force interact.

Why do the constants a and b depend upon the velocities of electrons A and B? The reason is as follows: the velocity v and frequency of spin motion ω of the electron vary according to the expression [2] $m\text{v}^2 = h\omega$ (where h is Planck's constant) and hence when v of electrons A and B vary, their ω also vary accordingly. When ω of electrons A and B increase, the strengths of magnetic fields, which they possess around themselves, increase. Consequently, the strength of pushing force by the lines of force of electron A on the electron B, and similarly the strength of pushing force by the lines of force of electron B on the electron A, Figs. 5(b) and 8(b), are increased. And hence the force between the electrons A and B is also increased. This increase in force is accounted in the expression (3.2) by variation in the constants a and b. [The increase in strength of magnetic field around the current carrying rod when the current through the rod is increased, occurs due to increase in strengths of magnetic fields around the electrons. Because, when the current increases, the velocities of electrons increase which increase their (electrons) ω. And due to increase in ω of electrons, the strengths of magnetic fields around the electrons increase, that consequently increase the strength of resultant magnetic field around the rod caused due to interaction between magnetic fields of electrons.]

Why do the constants a and b depend upon how many lines of force of electrons A and B interact? That is as follows: when the electron B lies exactly in the plane of electron A, the complete band of sets of co-centric lines of force of electron B lies exactly in front of the complete band of sets of co-centric lines of force of electron A. Therefore they all interact, and hence the force caused due to interaction between them happens to be maximum. When the electron B does not lie exactly in the plane of electron A but is shifted (forward or backward), only a part of band of sets of co-centric lines of force of electron B lies in front of a part of band of sets of co-centric lines of force of electron A. Therefore, now less number of sets of co-centric lines of force of electron B interact with less number of sets of co-centric lines of force of electron A, and hence the force caused due to interaction between them is reduced. As the shift of the electron B from the plane of electron A increases, fewer sets of co-centric lines of force of electron B lie in front of fewer sets of co-centric lines of force of electron A. Therefore fewer sets of co-centric lines of force of electron A and B interact. Hence the force caused due to their interaction is reduced. This variation in force is accounted in the expression (3.2) by variation in the constants *a* and *b*.

The force F is actually the resultant of two forces F' (attractive force caused due to interaction between the magnetisms of the electrons A and B) and F'' (repulsive force caused due to interaction between the charges of the electrons A and B), i.e. ***F = F' ± F''***, and as d decreases, F' and F'' both increase. Consequently, after attaining a maximum value at $d = D$ (where $d = e^{-1/b}$ *and* $> d'$), because at $d = D$, $(dF/dd) = 0$ and $(d^2F/dd^2) = -ve$, F starts decreasing as d decreases.

Although there is no mathematical proof but evidence is there from the established knowledge to verify the truth of the above expression (3.2), see section-(3.2.3 iii).

ii. When the electrons are in position as shown in Fig. 8(b)

The force caused due to interaction between the electrons A and B, when they are in position as shown in Fig 8(b), does not vary according to expression (3.2), but varies as

$$F \propto (M + e)^2 \exp(-a\,d^b) \quad \text{.......... (3.3)}$$

In this position, since the forces F' and F'' both are repulsive, the nature of variation of F with d happens to be different from the expression (3.2).

To verify the truth of expression (3.3) too, there is no mathematical proof. Evidence from the established knowledge is also not available, but it should be true because to cause, e.g. α and β decays, such force should come into play between nucleons (see section-3.2.3 i).

3.2.3 Important and striking conclusions (Determination of Nuclear Force and the actual cause of its origin)

i. Determination of the actual cause of origin of Nuclear Force

There are two types of forces, which come into play between two electrons:

1. That which is caused due to interaction between their charges; i.e. Coulomb force,

2. That which is caused due to interaction between their magnetic fields, i.e. the present force. This force:

(i) does not come into play between them always but comes into play only under certain conditions, e.g., when they are in position, Fig. 5(b), or in position, Fig. 8(b);

(ii) is charge independent (it since arises due to interaction between magnetic fields of electrons, obviously it happens to be charge independent);

(iii) is short-range (because it comes into play only when $d < 2r$);

(iv) is strong.

Over the claim that this force is strong, some may argue that if this force is strong, electron beams should persist for a long time as, e.g., laser beams persist. Why do electron beams not persist for a long time? The reason is that the velocities of electrons in electron beams are not exactly equal and unidirectional. For persistence of any beam these characteristics are necessary otherwise, due to collisions among the electrons, the persistence of the beam is destroyed (for detail, see reference-2).

The nuclear force, which happens to be charge independent, short-range and strong, therefore could be caused due to interaction between magnetic fields of nucleons, because the nucleons too possess magnetic field and the interaction between their magnetic fields must take place. But unfortunately, in any of the existing theories to explain the nuclear force, no account of interaction between magnetic fields of nucleons has been found. Surprisingly we take account of the interaction between charges of protons but totally forget to take account of the interaction between magnetic fields of nucleons. Can it ever be possible that the interaction between charges of protons takes place but not between magnetic fields of nucleons? Most surprisingly, in Yukawa's meson field theory [7], the field of virtual π mesons is assumed in the nuclei and their continuous exchange between the nucleons is assumed as the cause of origin of the nuclear force. But the concept of a field of virtual π mesons gives rise to several such questions for which no explanation can be given. For example, how can the field of virtual π mesons occur? How can virtual π mesons have charge, that is positive or negative? Can it practically ever be possible? If it is possible, then how is it possible? Can it be explained? These questions raise serious concerns about Yukawa's hypothesis of a field of virtual π mesons.

Most importantly, the force caused due to the interaction between magnetic fields of nucleons has a repulsive component too, which is necessary to cause, e.g. α and β decays etc. Whereas the continuous exchange of π mesons gives rise to only attractive forces. The existing assumption that the Coulomb repulsive force between the protons provides the repulsive force in nuclei to cause e.g. α and β decays etc. is not true. The Coulomb repulsive force is too weak (about 100 times) and hence it cannot cause α and β decays etc. The repulsive force should be strong, i.e. of the order of magnitude of attractive force. The Gamow's theory [8], though it explains the α decay successfully assuming Coulomb repulsive force as the cause behind it, is not true. Because it is based on the explanation of the phenomenon, Transmittance T = finite for particles having energy $E < V$ (where V is the barrier potential energy), assuming their (particles) wave nature, while this phenomenon takes place due to their particle nature, not because of their wave nature (see reference-2). Secondly, Gamow's theory fails to explain β decay, while it should explain that too.

ii. Determination of nuclear force

The force between the interacting nucleons should vary according to expressions (3.2) and (3.3) respectively when they are in positions as shown in Figs. 5(b) and 8(b). The nuclear force, varying according to expression (3.2), shall give rise to a super soft-core type of potential between the nucleons, which explains the scattering and nuclear matter properties on equal footing. And the nuclear force, varying according to expression (3.2), provides an explanation of nuclear decay etc.

iii. Evidence to confirm the truth of equation (3.2) as the expression for nuclear force

As the number of nucleons in nuclei increases, near the mass number A = 62, the binding energy per nucleon (E_b) is maximum (nearly 8.8 MeV, ${}^{62}_{28}Ni$ has E_b [9] = 8.7948 MeV) and then gradually decreases as A increases and ultimately for the heavy nuclei A > 200 (such as uranium, which are radioactive), its value becomes nearly 7.6 MeV. It confirms the truth of equation (3.2) as the expression for nuclear force, because equation (3.2) explains the above complete phenomena.

As the number of nucleons in the nucleus increases, due to increase in the density of nucleons in the nucleus, the inter-nucleon distance (d, Fig. 5) goes on narrower and narrower, and consequently the magnitude of force F (equation 3.2) between the nucleons increases. In the beginning, i.e. when A << 62, since the inter-nucleon distance (d) happens to be comparatively large (< 2r but close to 2r, Fig. 5), the rate of increase in the magnitude of force F'' happens to be almost negligible in comparison to the rate of increase in the magnitude of force F'. As A increases, the rate of increase in the magnitude of force F'' starts increasing but very gradually. And as A approaches near to 62, near the mass number A = 62, the inter-nucleon distances probably become so narrow that the charges of nucleons come very close to each other and consequently the rate of increase in the magnitude of force F'' becomes significant. But that does not become so much significant that $F(=F'-F'')$ starts decreasing. After attaining its (F) maximum value somewhere near A = 62, when A increases further, F starts decreasing. Because then, due to further increase in the closeness between the charges of nucleons, the rate of increase in the magnitude of force F'' becomes quite significant such that $F(=F'-F'')$ starts gradually decreasing. And ultimately for the heavy nuclei A > 200 (such as uranium, which are radioactive), the value of $F(=F'-F'')$ and hence of E_b becomes nearly 7.6 Mev. [There is lot of things more in the above complete phenomenon to explain, e.g.: i- why and how α and β particles are emitted from the nuclei when their A > 200, not the nucleons; ii- why and how neutrons become unstable. These shall be explained in my paper (mentioned in section-2) to be submitted for publication very shortly, because presently that is beyond the scope of this paper.]

3.3 EXPLANATION OF WHY AND HOW A MAGNETIC FIELD IS GENERATED AROUND A CURRENT CARRYING ROD, WHY AND HOW THAT FIELD OCCURS IN A PLANE PERPENDICULAR TO THE DIRECTION OF FLOW OF CURRENT AND POSSESSES DIRECTION, HOW AND WHICH TYPE OF MAGNETISM (ELECTROMAGNETISM) IS GENERATED

3.3.1 Explanation of why and how a magnetic field is generated around a current carrying rod

Inside the rod, since the emission of photons from the orbiting electrons of the substance goes on always, obviously they (photons) go on traveling here and there inside the rod. During their travel here and there inside the rod, the photons obviously collide with the current carrying electrons of the rod found in their way. (During their travel, the rod absorbs some photons and some are emitted out from the surfaces of the rod into the surroundings.) Due to their collisions, the directions of L_s (i.e. the directions of motion) of the electrons of the substances are randomly oriented in all the different directions of the substances. Since the directions of μ_s and L_s of the electron lie just opposite to each other, the directions of μ_s of the electrons of the rod are consequently also randomly oriented.

Hence, applying a battery when some potential difference is applied across the end of a rod, the randomly oriented directions of L_s of the free electrons of the rod start getting oriented and aligned parallel but opposite (because the electrons have negative charge) to the direction of the applied external electric field (for confirmation of its truth, see the section- 3.3.5). The electrons, of which the directions of L_s are oriented and aligned, start moving in the direction opposite to the field and give rise to electric current. But the photons existing in the rod try to disturb the alignments of directions of L_s (i.e. directions of motion) of electrons by colliding with them. But due to the presence of the applied electric field, the alignments of directions of L_s of electrons are not being disturbed. The applied electric field does not let their alignments be disturbed. If the magnitude of the applied electric field is increased, the directions of L_s of more number of electrons are oriented and aligned and the electrons are accelerated too; consequently the magnitude of current is increased.

When the directions of L_s of the electrons are oriented and aligned, the directions of μ_s of the electrons are also oriented and aligned parallel, but i.e. along the direction of the field. The planes of their magnetism (occurring in the form of a ring) and magnetic fields are oriented and aligned too in a plane perpendicular to the direction of the applied field, i.e. perpendicular to the direction of flow of current.

When the electrons move through any rod, they move through its different inter-lattice passages. During their movements, they can be assumed as moving in the form of a number of queues (or columns) through every inter-lattice passage of the rod. The electrons passing through, e.g., inter-lattice passage, say 1, in number of queues can be assumed as, a beam of electrons passing through the inter-lattice passage 1. The magnetic fields of electrons, passing through this passage 1 (and similarly though 2,3,4,5….) in the form of a beam, as a consequence of their interaction (as has been explained in section-3.2) create magnetic field around and along the length of the beam, and hence around and along the length of the passage 1 a magnetic field is created in coaxial hollow cylindrical forms, as shown in Fig. 7(c_2). The electrons moving through successive different inter-lattice passages in the form of beams can be considered to be moving through different successive current carrying wires placed close and parallel to each other in a group. As in a solenoid, due to interaction between the magnetic fields developed around the different successive turns of the solenoid, closed loops are created (Fig. 17, reference-4) around the solenoid, here too, due to interaction between the magnetic fields developed around and along the lengths of different successive inter-lattice passages, Fig. 9 (a, b and c), closed loops are created around and along the length of the rod, and finally there is obtained a magnetic field in coaxial hollow cylindrical form around and along the length of rod, as shown in Fig. 10(a_2).

If the transverse cross-section of the specimen rod is of a circular type, the transverse cross-section of the magnetic field obtained around and along the length of the rod shall also be of circular type, as shown in Fig. 10(a_1). If the rod is quite thick and has a rectangular type of transverse cross-section, the transverse cross-section of the magnetic field around and along its length shall be of rectangular type, Fig. 10(b). If the rod is quite thick and has a square type of transverse cross-section, the transverse cross-section of the magnetic field around and along its length shall be of square type, Fig. 10(c). If the rod is thin but quite wide (thin beam type) the transverse cross-section of magnetic field around it might be elliptical. If the rod is very thin (wire type), having an arbitrarily shaped transverse cross-section, the transverse cross-section of magnetic field around it tends to be circular far from the wire.

3.3.2 Explanation of why and how the magnetic field generated around the current carrying rod occurs in a plane perpendicular to the direction of flow of current through the rod and it (magnetic field) possesses direction

When the current flows through a rod, since the planes of magnetism and magnetic fields are oriented and aligned in a plane perpendicular to the direction of flow of current, the plane of the resultant magnetic field, created around and along the length of the rod due to interaction between magnetic fields of electrons of the rod, lies in a plane perpendicular to the direction of flow of current through the rod. Consequently the magnetic field, generated around the current carrying rod, occurs in a plane perpendicular to the direction of flow of current through the rod.

Further, since the directions of μ_s of the electrons of the rod are oriented and aligned along the direction of flow of current, the directions of spin motion of magnetism and magnetic fields of the electrons and hence the resultant magnetic field generated around the rod occurs in a clockwise direction (if the direction of flow of current in the rod is towards the face of the clock). If we examine the direction of this magnetic field, we find it to be in a clockwise direction

3.3.3 How and which type of magnetism (electromagnetism) is generated in the rod

When some electric current is allowed to flow through a specimen rod in its normal state and when some persistent current starts flowing through the rod in its superconducting state, we find that a magnetic field is generated around the rod, i.e. some magnetism has been generated in the rod. The flow of current (whether electric current at normal state or persistent current at superconducting state) through the rod means that there is a flow of free electrons of the rod through it from its one end to other. The flow of free electrons in the rod implies alignment of directions of their μ_s in the direction opposite to the direction of their motion (i.e. opposite to the direction of their flow). It also implies alignment of planes of their magnetism and magnetic fields in a plane perpendicular to the direction of their flow (for confirmation of alignments of directions of L_s, μ_s and planes of magnetism and magnetic fields of the free electrons of the rod, see the section-3.3.5). Due to alignment of μ_s of free electrons, the rod obtains a magnetic moment, and due to alignment of planes of magnetism and magnetic fields of free electrons, the rod obtains magnetism (electromagnetism) and magnetic field respectively.

If the magnetism (electromagnetism), which the rod obtains in its superconducting state, is diamagnetism (very low magnetism acquired by the substance in direction opposite to the field), the magnetism, which the rod obtains in its normal state must also be diamagnetism (for its experimental confirmation, see the section-3.3.4).

3.3.4 Experimental confirmation that the magnetism (electromagnetism) generated around the current carrying rod is diamagnetism

Consider a specimen rod over which a primary and a secondary coil are wound. The primary is connected to the battery through a key and the secondary is connected to a ballistic galvanometer. If some current is allowed to flow through the rod, a kick in the galvanometer reading is observed, which implies that a change of flux has taken place. The change in flux takes place when the current is allowed to flow through the rod.

If, instead of allowing the current to pass through the rod, the rod is brought down to its transition temperature T_c (the temperature below which the resistivity of a metal or alloy becomes zero and a persistent electric current starts flowing through that metal or alloy), then too a similar kick in ballistic galvanometer reading is observed. The magnetism generated in the rod at its transition temperature since happens to be diamagnetism (see Meissner effect [10, 11]); the magnetism generated in the current carrying conductor should also be diamagnetism.

3.3.5 Confirmation of truth that the directions of L_s of electrons of the specimen rod are oriented and aligned when current starts flowing through that rod

We take an iron bar and place it in the magnetic meridian of earth's magnetic field (or in an external magnetic field such that the length of the bar is parallel to the direction of external magnetic field). If this iron bar is magnetized such that its north pole lies towards the geographical south pole of the earth (or towards the north pole of the external magnetic field) and south pole towards the geographical north pole of the earth (or towards the south pole of the external magnetic field), we find that all the magnetic lines of force of earth's magnetic field (or external magnetic field) are expelled out from the iron bar which were earlier passing through the bar when it was not magnetized. The expulsion of magnetic lines of force of earth's magnetic field (or external magnetic field) from the bar takes place because when the bar is magnetized, its lines of force start occurring, and according to property of magnetic lines of force, since they neither intersect themselves nor other lines of force, the lines of force of earth's magnetic field (or external magnetic field) are expelled out from the bar.

Similarly, when the lines of force of external magnetic field are expelled out from the specimen rod when current starts flowing through it (previous experiment, section-3.3.4), it means, some magnetic lines of force start occurring in the rod, which are so oriented and aligned that they block the lines of force of the external magnetic field (i.e. the magnetic field developed around the steady current carrying primary coil) to pass through the rod, consequently they are expelled out from the rod as shown in Fig. 11. The lines of force, which block the external magnetic lines of force to pass through the rod, do not come from outside but are created when the current starts flowing through that rod. The magnetic fields of electrons of the rod are oriented and aligned such that the lines of force of external magnetic field are blocked when the current starts flowing through the rod. Other than electrons, there exists no other source, which possesses a magnetic field and whose magnetic field can be assumed to be oriented and aligned.

The expulsion of the lines of force of external magnetic field (i.e. the magnetic field developed around the steady current carrying primary coil) from the specimen rod can be understood as follows too: when the current is allowed to flow through the rod, the free electrons of the rod start flowing. Due to their flow the passages for the lines of force of the external magnetic field through the rod become blocked. The blocking of passages is possible only if the free electrons of the rod are oriented such that the planes of their magnetic fields start lying in a plane perpendicular to the direction of magnetic lines of force of external magnetic field. Because then, in order to pass through the rod, the magnetic lines of force of external magnetic field will have to intersect the lines of force of magnetic fields around the electrons, which they cannot do. Consequently, they are expelled out from the rod.

It is therefore confirmed that when the current starts flowing through the rod, the magnetic fields of its electrons are oriented and aligned. And when magnetic fields of electrons of the rod are oriented and aligned, their μ_s and L_s are also oriented and aligned accordingly.

3.3.6 Important conclusion

The magnetic moment of electron (μ_s) and magnetic moment of current carrying rod are actually the magnetic moments, not the magnetic dipole moments. Because, by convention, the magnetic dipole means, it has two poles South and North, and South pole is through which the magnetic lines of force of the dipole enter the dipole and North pole is through which the magnetic lines of force exit out from the dipole. For example, the bar magnet, Fig.3, where, through its South pole, its magnetic lines of force (m_3 , m_4, m_5) enter the bar magnet and through the North pole, the magnetic lines exit out from the bar magnet. Similarly, the electronic orbit, see section-3.4.1 and Fig. 11(a), and the current carrying close loop, see section-3.4.2 and Fig. 11(b), where, through their South poles, their lines of force enter and through their North poles, the lines of force exit from them. While the magnetic lines of force of the electron, Fig. 1, and current carrying rod, Fig. 7(c_2), do not enter and exit out from them, consequently no poles are created.

Further, if the magnetic dipole, e.g., a bar magnet is placed in an external magnetic field as shown in Fig. 3, the lines of force of the external magnetic field (3, 4, 5, 6, 7, 8) also enter the bar magnet through its South pole and exit from the North pole. And if the bar magnet is placed rotating it by 180°, i.e. the North pole lies towards the geographical South pole of the earth**,** the lines of force of the external magnetic field do not enter the bar magnet through its North pole but they are repelled out. While if a current carrying rod or an electron is placed in an external magnetic field, as shown in Fig. 11 and Fig. 4 respectively or by rotating them by 180°, in both the cases, the lines of force of the external magnetic field are expelled out as shown in Figs. 11 and 4 respectively (why and how the lines of force of the external magnetic field are expelled out, see the section- 3.3.5).

Hence, the magnetic moments of electron and current carrying rod cannot be the magnetic dipole moments.

3.3.7 Discussion

To the author's knowledge, no explanation has been found as to how (i.e. way) the magnetic field is generated around a current carrying rod. It is merely assumed that due to flow of charge through the rod, a magnetic field is generated around it, and that is all. It is quite surprising that the electrons possess charge and magnetism (and hence magnetic field) both while we take into account only their charge and overlook completely their magnetism. Can it be possible that during the flow of electrons, the magnetism of electrons plays no role and only their charge plays a role? If possible, how is it possible? Can it be explained? It is more surprising that during the flow of electrons, the magnetic field is generated around the rod, and the electrons possess magnetism but we do not take any account of their magnetism, instead we assume that the magnetic field is generated due to flow of their charge. It is unbelievable. For the time being if we assume that the magnetism of electrons remain inactive and play no role in the generation of magnetic field around the rod, can it be possible that the magnetic field of electrons will not interact with the magnetic field, which is generated around the rod due to flow of charge of it's electrons? If possible, how is it possible? Can it be explained? If not possible, then what happens when their fields interact?

Since the magnetic field produced around the current carrying rod persists as long as the current flows through the rod, and no disturbance is observed in the persistence of field, it implies that the magnetic field of electrons do not interact with the magnetic field produced around the rod. No interaction between the magnetic fields of electrons and magnetic field generated around the rod can be possible if the electrons do not possess any magnetic field or the magnetic field produced around the rod is not being produced due to flow of charge but produced due to the magnetic fields of electrons. Since the possession of magnetic field by the electron cannot be ruled out because it is a well-observed fact, the production of magnetic field due to flow of charge of electrons should not be true.

When the electromagnetic theory is examined, an expression is found, known as Ampere's law [12], which gives a mathematical relation between Curl of magnetic field B, produced near any current carrying rod, and the current density *J* as follows

$$\text{Curl } \mathbf{B} = \mu_0 \mathbf{J} \quad \ldots\ldots\ldots\ldots \quad (3.4)$$

where μ_0 is the permeability of the medium. No explanation is found anywhere as to: 1- Why (i.e. cause) and how (i.e. way) this magnetic field is produced around the rod? 2- Why and how does this field occur in a plane perpendicular to the direction of flow of current and possesses direction, i.e. clockwise (if the direction of current is towards the face of the clock)? 3- How and which type of magnetism (electromagnetism) is generated?

The magnetic field is produced around the rod in a plane perpendicular to the direction of current and possesses direction it means, there occurs positively a cause due to which the magnetic field is produced around the rod, and occurs a way how this field is produced in such a fashion. Therefore, we must have their clear and complete knowledge, which unfortunately we do not have. The electromagnetic theory fails to give any knowledge regarding these.

Further to this, the electromagnetic theory gives no knowledge regarding which type of magnetism is produced in the current carrying rod. Since the magnetism is produced, we must have knowledge, which type of magnetism is produced. But unfortunately, there exists no knowledge regarding this.

The present theory gives clear and complete knowledge of why (i.e. cause) and how (i.e. way) the field is produced around the rod, why and how it occurs in a plane perpendicular to the direction of current, why and how it possesses direction. The present theory also gives us the knowledge that the magnetism generated in the conductor is diamagnetism.

3.4 EXPLANATION OF HOW MAGNETIC NORTH AND SOUTH POLES ARE CREATED IN ELECTRON ORBITS AND IN CURRENT CARRYING CLOSED LOOPS AND THEY BEHAVE LIKE MAGNETIC DIPOLES

3.4.1 How magnetic north and south poles are created in electron orbits and they (orbits) behave like magnetic dipoles

Since the electron always moves in the direction of its L_s (see the reference-2), hence when it moves along its orbit, the direction of its L_s is always tangential to the surface of the orbit at its every point through which the electron passes during its orbital motion. Consequently, the magnetism and magnetic field of the electron happen to be always in a plane perpendicular to the direction of orbital velocity of the electron at every point of its orbital path. Therefore, during the motion of electron with velocity v along its orbit in the direction marked by arrows (anticlockwise), Fig. 12(a), the lines of force round the magnetism of electron enter the space A through the upper surface of the orbit, and after their exit through the lower surface of the orbit, turning round the thickness of the orbital path, Fig. 12(a), they reach again towards the upper surface of the orbit to pass through it. In this way, the magnetic field is produced round the thickness of the orbital path of the electron as shown in Fig. 12(a). The magnetic field thus created has the form similarly as if we take one end of a wire and passing it through the centers of a number of circular small rings (each ring is composed of several co-centric rings) join it to the other end of the wire giving the wire a circular (or elliptical) shape. The South pole is assumed by convention to be created near the upper surface and North pole near the lower surface of the orbit, and a magnetic dipole moment μ_l is associated with it.

3.4.2 How magnetic north and south poles are created in current carrying closed loops and they (loops) behave like magnetic dipoles

Around a current carrying conductor, the magnetic field is produced in a manner as explained in section-3.3.1. When the conductor is taken in the form of a closed loop (e.g. anchor ring), the lines of force of magnetic field, produced around the closed loop, enter the space A through the upper surface of the loop, and after their exit through the lower surface of the loop, turning round the thickness of the loop, Fig. 12(b), they reach again towards the upper surface of the loop to pass through it. In this way, the magnetic field is produced around the thickness of the whole loop as shown in Fig. 12(b). The magnetic field thus created has the form similarly as if we take one end of a flexible thin rod and passing it through the centers of a number of circular small rings (each ring is composed of several co-centric rings) join it to the other end of the rod giving the rod a closed loop shape. The South pole is by convention assumed created near the upper surface and North pole near the lower surface of the loop.

3.4.3 Discussion

No clear and complete explanation is found as to how the orbit of an electron behaves like a magnetic dipole and how it's two magnetic poles are created. Whatever explanation is found is that, due to motion of electron along its orbit, it can be assumed that the negative current flows along the orbit in the direction of motion and hence the magnetic field is produced around the orbit of electron and the orbit starts behaving like a dipole. But it gives rise to several such questions of which no explanation can be given. The questions are for example: 1. Since the electron possesses magnetic field too, can it be possible or believed that the magnetic field of electron remains inactive and plays no role in creating the magnetic field around its orbit, instead it is created due to flow of charge of electron? 2. Supposing the magnetic field around the orbit of electron is created due flow of charge of electron, can it be possible or believed that the magnetic field of electron does not interact with that magnetic field produced around the orbit of electron due to flow of it's charge? 3. Supposing the magnetic field around the orbit of electron is created due to the magnetic field which the electron possesses (if it is assumed that the magnetic field possessed by the electron is obtained due to the spin motion of the charge of electron), does that magnetic field of electron always lie in a plane perpendicular to the direction of orbital velocity of electron (because otherwise the possession of two poles by the orbit of electron cannot be explained)? If lies, how? Can it be explained? These questions imply the existing explanation is incorrect.

Similarly, how a current carrying closed loop behaves like a magnetic dipole and how its two magnetic poles are created, no clear and complete explanation is found. Whatever explanation is found is that, due to flow of current through the loop, a magnetic field is produced around it and it starts behaving like a magnetic dipole. But it gives rise to the questions; does that magnetic field occur in a plane perpendicular to the direction of length of the loop at every point of its length (because otherwise the possession of two poles by the loop cannot be explained)? If occurs, how? Can it be explained?

The present theory gives a very clear understanding, without giving rise to any such questions as mentioned above.

NOTE: Applying the present theory, the following phenomena can also be explained very clearly and completely.

1. Why and how a current carrying rod is deflected when it is placed in an external magnetic field with its length perpendicular to the direction of external magnetic field, why and how it is not deflected when placed parallel to the direction of external magnetic field or when it carries no current.

2. Why and how two parallel current carrying rods are deflected when i- the currents flowing through the rods are in same direction, ii- the currents flowing through the rods are in opposite directions.

The existing theories explain the above phenomena. But there are some big faults. The assumptions, which have been taken, are practically impossible. And the rules and/or mathematical expressions have been formulated on empirical basis. These although explain the phenomena but fail totally to explain why and how these phenomena take place.

4. POSSIBLE NEW EFFECTS: IF A CURRENT CARRYING CLOSED LOOP IS PLACED IN A PLANE PERPENDICULAR TO THE DIRECTION OF AN EXTERNAL MAGNETIC FIELD, THE LINES OF FORCE OF THE INTERACTING EXTERNAL MAGNETIC FIELD AND THE FIELD GENERATED ROUND THE LOOP SHALL BE DEFORMED AND CONTRACTION/EXPANSION IN THE LENGTH OF THE LOOP WILL TAKE PLACE

4.1 Why, how and when contraction in the length of the loop shall take place

Let an electric current carrying circular closed loop of radius R is placed in a plane perpendicular to the direction of an external magnetic field and the direction of flow of current i in the loop is anticlockwise (when the direction of external magnetic field is towards the face of the clock), as shown by long arrows inside the ring in Fig. 13 (a). Let us assume the whole length of the loop is made up of large number (N) of very small pieces of rods (every piece is just like a thin slice) 1, 2, 3, ……, N. On every slice like piece, the Lorentz force shall come into play, which shall act radially (i.e. along the radius) towards the center of the loop. Therefore, every slice shall experience a force, acting radially towards the center of the loop, and consequently the loop shall get contracted, i.e., the length of the loop (= $2\pi R$) shall be reduced. The contraction in the length of the loop shall depend upon the strength of the current i and the strength of the external magnetic field.

When the length of the loop $(= 2\pi R)$ shall be reduced, obviously its area A $(= \pi R^2)$ shall also be reduced. Due to decrease in the length of the loop, the strength of current i shall be increased, which shall increase the magnetic dipole moment ($\mu = i\ A$) of the loop, but due to reduction in A, the increase in μ shall be balanced and finally μ shall remain unchanged.

4.2 How the lines of force of the interacting external magnetic field and the magnetic field generated around the loop shall be deformed when the contraction in the length of the loop shall take place.

When an electron or an electron beam is moving perpendicular to the direction of an external magnetic field, or an electric current carrying rod is placed with its length perpendicular to the direction of an external magnetic field, due to interaction between their magnetic fields (i.e. between external magnetic field and magnetic field around the electron/ electron beam/ electric current carrying rod), the lines of force of interacting magnetic fields are deformed and a neutral space is created, towards which the Lorentz force comes into play on the electron/ electron beam/ electric current carrying rod, as shown in Fig. 2(a). Similarly, due to interaction between external magnetic field and magnetic field generated around every slice, their lines of force shall be deformed, and finally deformation around the loop shall be obtained as shown in Fig. 13(a). Beneath every slice [i.e. the place, lying near the inner circular edge and radially towards the center of the loop in Fig. 13 (a)], a neutral space shall be created, the lines of force shall be deformed around that neutral space and the Lorentz force shall come into play acting towards that neutral space similarly as has been shown in Fig. 2(a). But, in order to avoid complications in the diagram, neutral spaces, deformation in lines of force around the neutral spaces etc. have not been shown in Fig. 13 (a). Since the direction of Lorentz force on every slice (acting towards the neutral space, created beneath that slice) shall be radially towards the center of the loop, the loop shall be contracted.

4.3 Why, how and when the expansion in the length of the loop shall take place.

If the direction of current i in the loop is clockwise, shown by long arrows inside the loop in Fig. 13 (b), on every slice, the Lorentz force shall act in direction radially away from the center of the loop. Therefore, every slice shall experience a force, acting radially away from the center of the loop, and consequently the loop shall get expanded, i.e., the length of the loop (= $2\pi R$) shall increase. The expansion in the length of the loop shall depend upon the strength of the current i and the strength of the external magnetic field.

When the length of the loop (= $2\pi R$) shall be increased, obviously its area A ($= \pi R^2$) shall also be increased. Due to increase in the length of the loop, the strength of current i shall be reduced, which shall decrease the magnetic dipole moment ($\mu = i\ A$) of the loop, but due increase in A, the decrease in μ shall be balanced and finally μ shall remain unchanged.

4.4 How the lines of force of the interacting external magnetic field and the magnetic field generated around the loop shall be deformed when the expansion in the length of the loop shall take place.

Due to interaction between the external magnetic field and the magnetic field generated around each slice, their lines of force shall be deformed, and finally the deformation around the loop shall be obtained as shown in Fig. 13 (b). Above every slice [i.e. the place, lying near the outer circular edge and radially away from the center of the loop in Fig. 13 (b)], a neutral space shall be created, the lines of force shall be deformed around that neutral space and the Lorentz force shall come into play acting towards that neutral space similarly as has been shown in Fig.

2(a). But, in order to avoid complications in diagram, neutral spaces, deformation in lines of force around the neutral spaces etc. have not been shown in Fig. 13 (b). Since the direction of Lorentz force on every slice (acting towards the neutral space, created above that slice) shall be radially away from the center of the loop, the loop shall expand

5. EFFECTS OF THE PRESENT THEORY ON SOME EXISTING CONCEPTS, USED IN SPECTROSCOPY ETC., AND THEIR CONSEQUENCES

5.1. EFFECTS

The classical result of μ_s when compared to measurement is off by a proportional factor g and hence the expressions (1.2) and (1.3) are corrected multiplying respectively with correction factors g_l and g_s as

$$\mu_l = g_l\,(-e/2m)\,L_l \quad (5.1)$$

and $$\mu_s = g_s\,(-e/2m)\,L_s \quad (5.2)$$

The dimensionless correction factor g is known as the g factor. The spin g factor $g_s = 2$, and it comes from the Dirac equation, a fundamental equation connecting the electron's spin with its electromagnetic properties. And the orbital g factor $g_l = 1$ comes by a quantum mechanical argument analogous to the derivation of the classical gyromagnetic ratio.

As in the expressions (5.1) and (5.2), μ_l is related to L_l and μ_s is related to L_s respectively, similarly the total magnetic dipole moment resulting from both spin and orbital angular momenta of an electron is related to the total angular momentum $L_j = L_l + L_s$ by

$$\mu_j = g_j\,(-e/2m)\,L_j \quad (5.3)$$

where the g factor g_j is known as the Lande g factor, which can be related to g_l and g_s by quantum mechanics.

For g_s, the most accurate value has been experimentally determined to have the value 2.00231930419922 ± (1.5×10^{-12}). It is only two thousands larger than the value from the Dirac equation. The small correction is known as the anomalous magnetic dipole moment of the electron.

But in the above description [13], there are faults in some of the concepts. For example:

1. μ_s is the magnetic moment of electron, not it's magnetic dipole moment, because μ_s has no pole (see the sections-2 and 3.3.6). Further, since μ_s is caused due to spin motion of the magnetism of electron, not due to spin motion of the charge of electron, and secondly, the expression (1.3) has been obtained by analogy with the expression (1.2), not applying the cause due to which μ_s arises, expression (1.3) is not correct and a correction factor g_s is needed to correct it as shown in expression (5.2).
2. μ_l is the magnetic dipole moment of the orbit of electron, not of electron. (How μ_l is created and possesses two poles, see section-3.4.1.). Secondly, since the expression (1.2) has been obtained following the well-verified expression (1.1), the correction factor is not needed. Although, in the expression (5.1), g_l has been introduced as a correction factor, but it has value 1.
3. μ_l is not a physical observable, as μ_s is, because μ_l is in fact not generated but associated (see section- 3.4.1). Consequently, there is no experimental evidence of μ_l, as μ_s has. Hence, on the name of spin orbit interaction, to determine μ_j as $\boldsymbol{\mu}_\mathbf{j}$ = (-e /2m) $\mathbf{L_j}$ (where L_j = jh /2π, j = s ± l and s, l and j respectively are the spin, orbital and total quantum numbers, and correction factor g_j has been excluded) = ($\boldsymbol{\mu}_\mathbf{s} \pm \boldsymbol{\mu}_\mathbf{l}$) is not fair and

meaningful. Secondly, the expression L_j = jh /2π [= (s ± l) h/2π = L_s ± L_l] is not true. In it, L_l = lh/2π can be accepted because L_l = lh/2π is according to postulate of Bohr's theory, but L_s = sh/2π cannot be accepted, because, regarding spin motion of electron, there is no postulate. Thirdly, since μ_s is the magnetic moment of electron while μ_l is the magnetic dipole moment of the orbit of electron, and further, μ_s acts along the perimeter of the orbit tangentially at its every point while μ_l acts along the axis of the orbit passing normally through its center, how can their vector sum be taken? Suppose if their vector sum is taken, will that be whether the magnetic moment or magnetic dipole moment and of what?

Further, the quantum numbers l (orbital), s (spin) and j (total) are just like the mathematical tools, and to these the values (e.g. 0, 1, 2, 3, …to l, and 1/2, -1/2 to s) are assigned according as the requirements demand in order to obtain the desired results. These have neither any physical significance nor interpretation. Furthermore, the assignment of two values (1/2 and –1/2) to s is not true. Because the electron spins always in a plane perpendicular to the direction of its orbital velocity and in clockwise direction (if the direction of orbital velocity of the electron is normally towards the face of the clock), and hence to s, only one value can be assigned, not two values (1/2 and –1/2). Therefore, j (= s ± l) can have only one value corresponding to each value of l, not more than one value.

5.2 CONSEQUENCES

Since i- the determination of μ_j is not fair and meaningful, ii- the expression L_j = jh /2π is not true, iii- when j (= s ± l) can have only one value corresponding to each value of l, not more than one value, the existing theories shall fail to explain the fine structures of spectral lines.

There is in fact no need of expressions (5.2) and (5.3), quantum numbers s, l, j, and g factor because the fine structures of spectral lines can be explained without taking their any account, that too, very clearly and completely, i.e. why and how the fine structures of spectral lines, variations in their (fine lines) numbers, frequencies and intensities etc. take place (see reference-2). The existing theories [which take account of expressions (5.2) and (5.3), quantum numbers s, l, j, and g factor] succeed somehow to give knowledge only about the numbers of fine lines and their intensities. But they fail to explain why and how the fine structures of spectral lines take place etc., because they are not based on the cause due to which the spectral lines, their fine structures, variations in their numbers, frequencies and intensities etc. take place.

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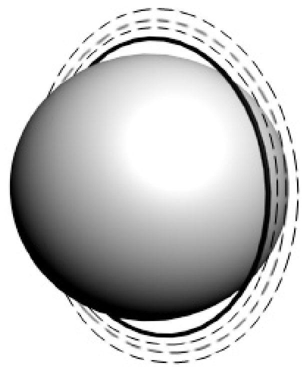

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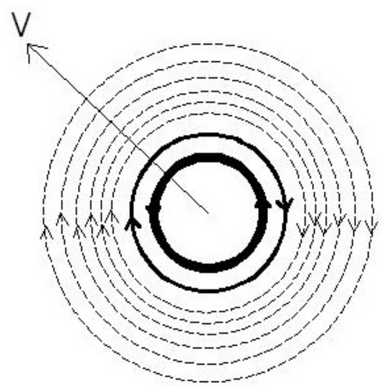
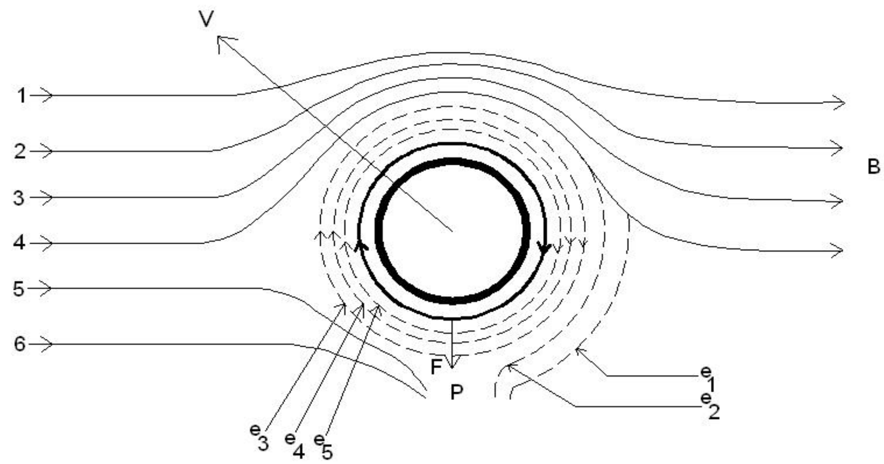


(b)

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



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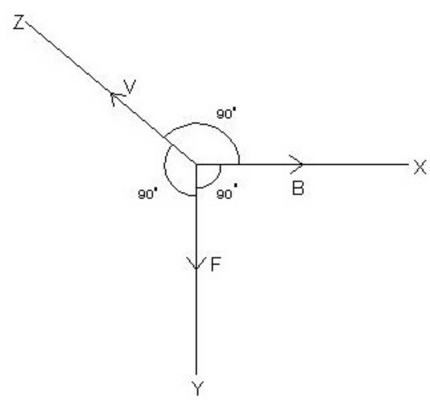


(b)

Fig. 2: (a) Transverse cross sectional view of interaction between the magnetic field that occurs around electron and the external magnetic field B. (b) X and Y are in the plane of the page and Z is perpendicularly upward to the plane of the page.

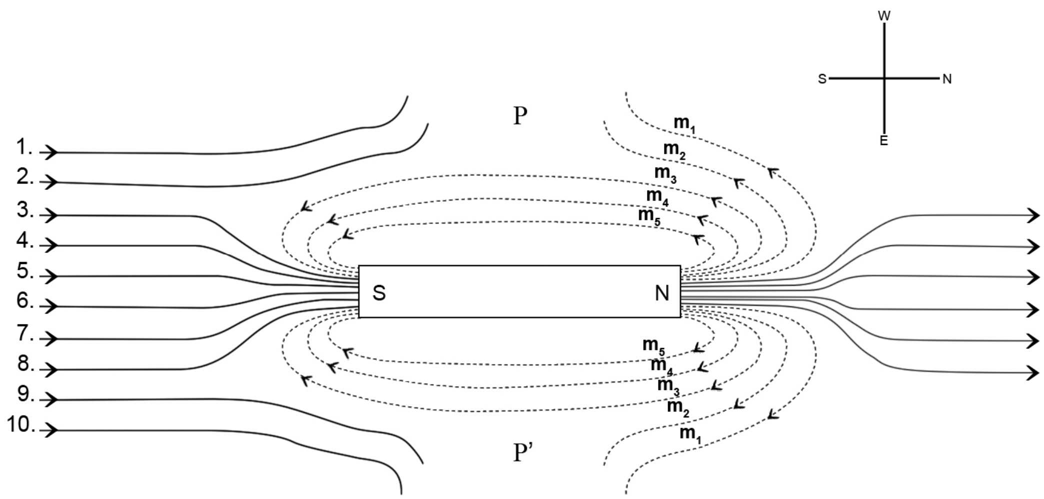


Fig. 3: Longitudinal cross sectional view of interaction between the earth's magnetic field and the magnetic field around a bar magnet, placed in magnetic meridian.

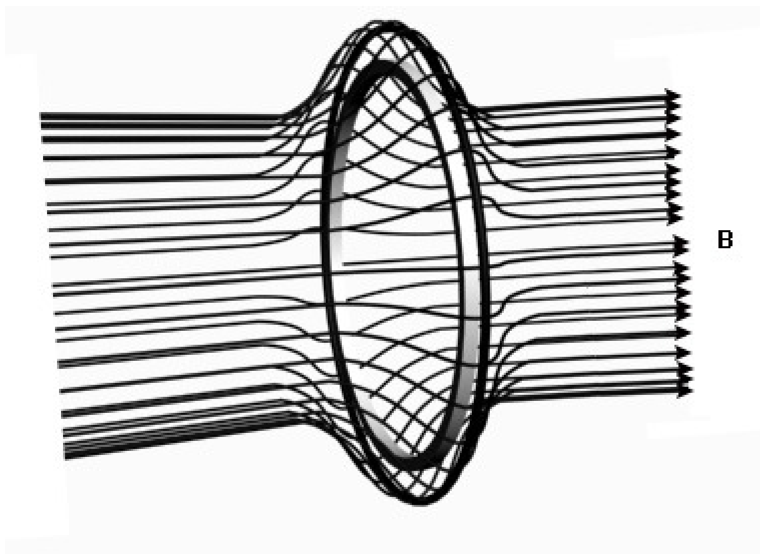
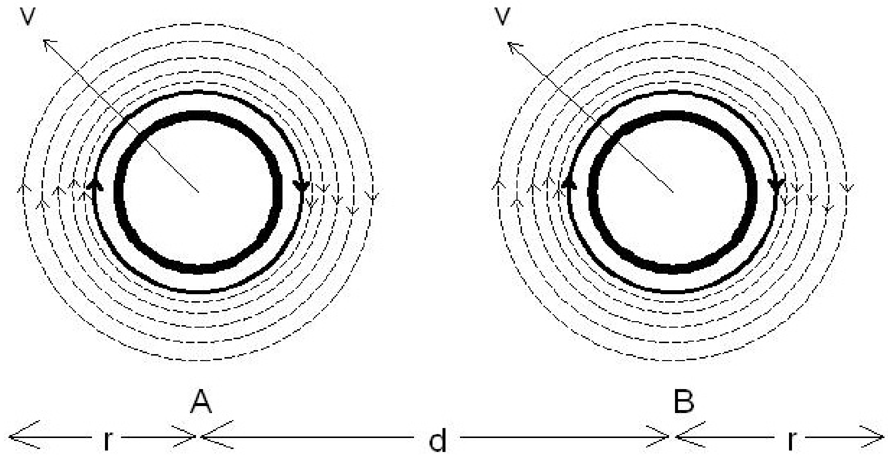


Fig. 4: Longitudinal view of deviation in the path of magnetic lines of force of external magnetic field when the plane of magnetic field of the electron lies in a plane perpendicular to the direction of external magnetic field. The inner and outer thick circles represent respectively the ball of charge and magnetic ring of the electron. In order to avoid complications in the diagram, magnetic lines of force of electron have been not shown.



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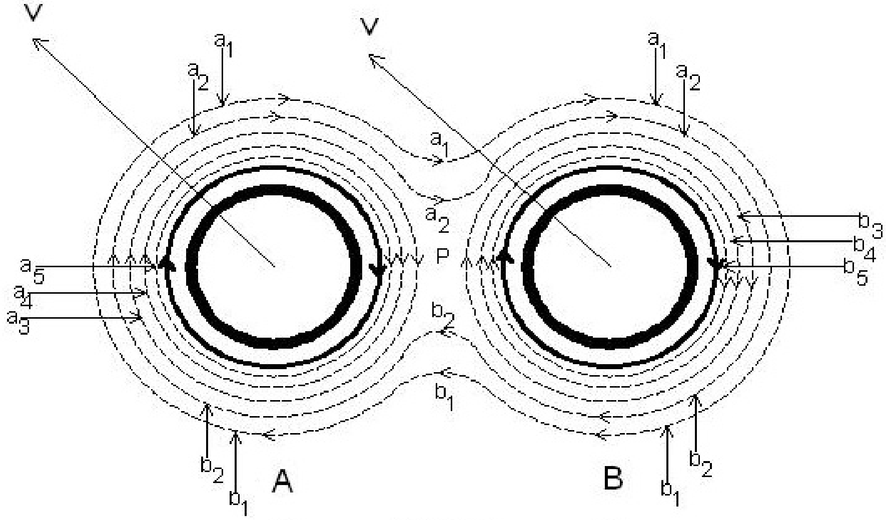
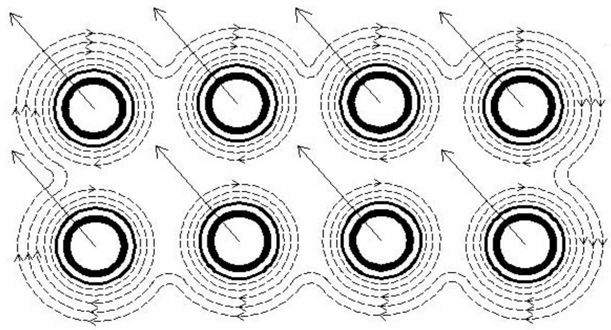


(b)

Fig. 5: (a) Transverse cross sectional view of motion of two electrons A and B lying in the same plane and at distance *d* apart while moving parallel to each other in the same direction with the same velocity v; (b) Transverse cross sectional view of interaction between their magnetic fields when the distance *d* between them is reduced to < 2r.



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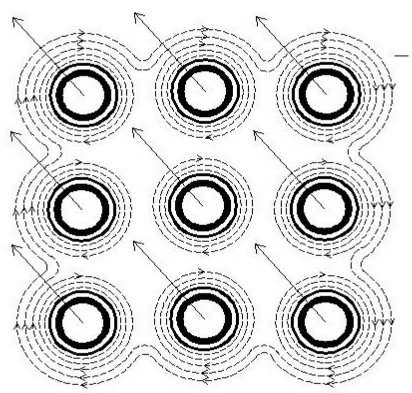

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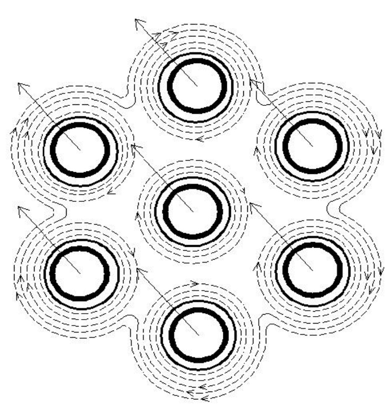
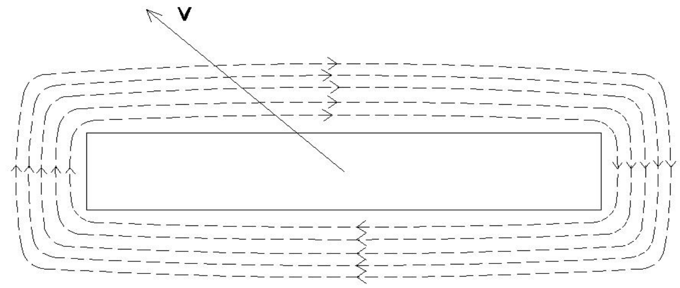


(c)

Fig. 6: (a), (b), and (c) Transverse cross sectional view of interaction between the magnetic fields of electrons lying in the same plane while moving parallel to each other in the same direction with the same velocity v.



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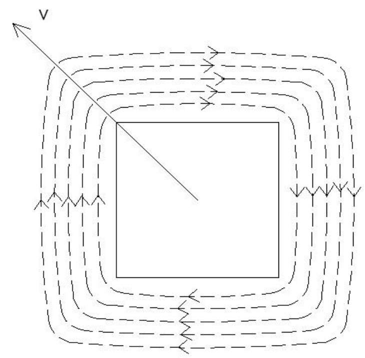

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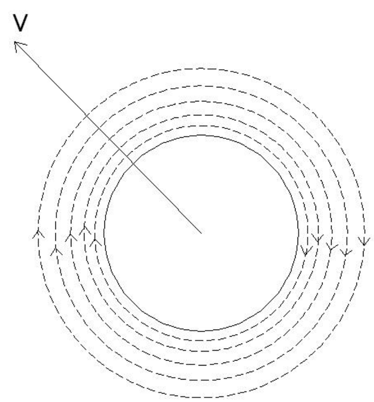
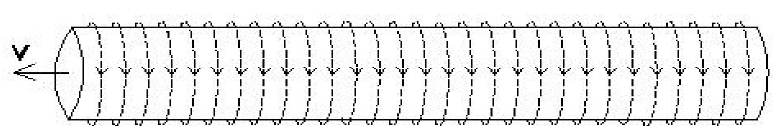
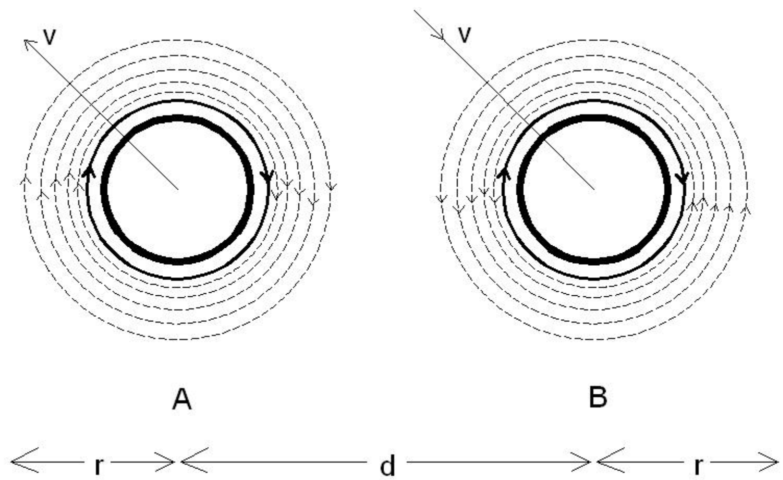


(c_1)



(c_2)

Fig. 7: (a), (b), and (c_1) Transverse cross sectional views of magnetic fields created around the electron beams having cross sectional area of different shapes. (c_2) Longitudinal view of magnetic field created around the electron beam.



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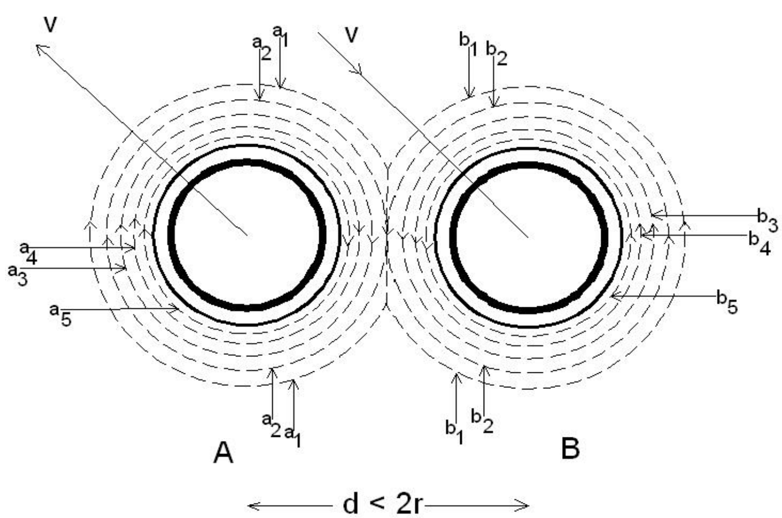
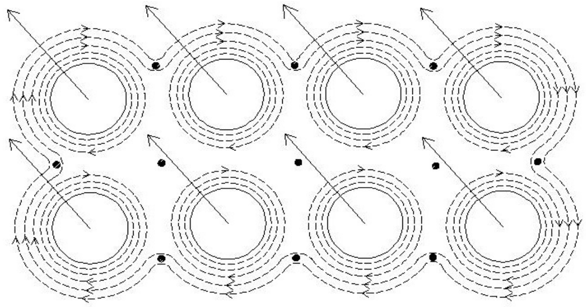


(b)

Fig. 8: (a) Transverse cross sectional view of motion of two electrons A and B at the instant when they are in the same plane and at distance *d* apart while moving parallel to each other with same velocity v but opposite in directions. (b) Transverse cross sectional view of interaction between their magnetic fields when the distance d between them is reduced to < 2r.



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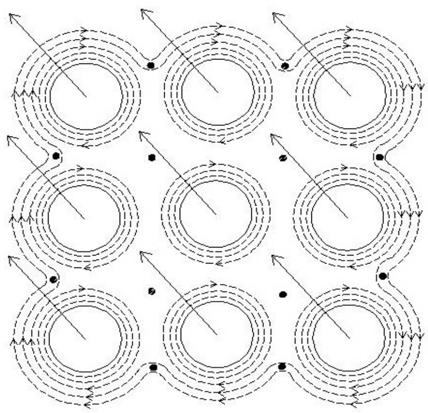

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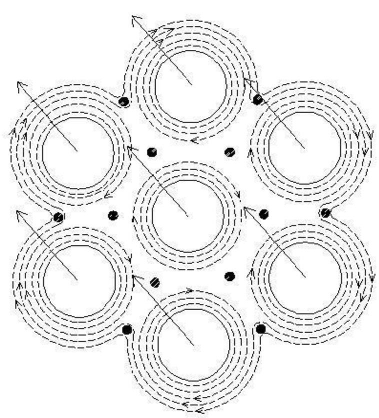
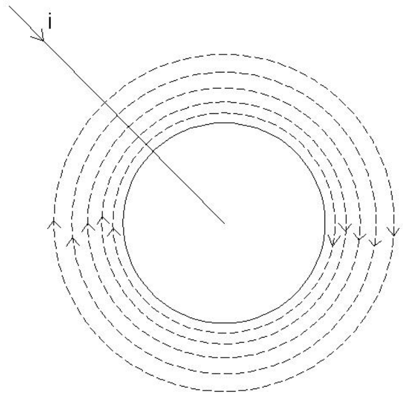
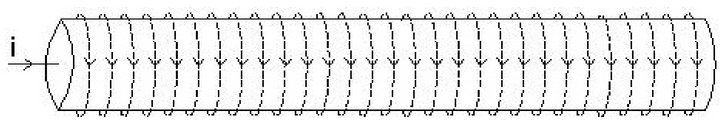


(c)

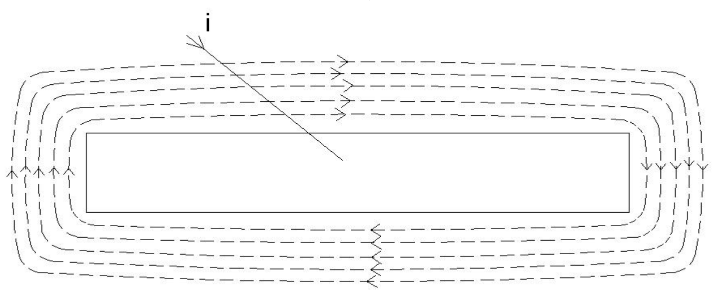
Fig. 9: (a), (b), and (c) Transverse cross sectional view of interaction between the magnetic fields created around electron beams (formed due to motion of electrons in number of queues through different inter lattice passages) while moving parallel to each other in the same direction with the same velocity v. Very small solid dark disks represent the atoms of the substance.



(a_1)



(a_2)



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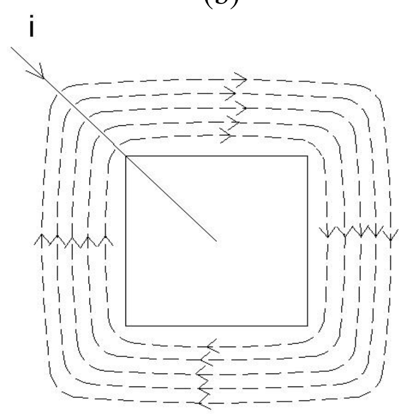


(c)

Fig. 10: (a_1), (b), and (c) Transverse cross-sectional view of magnetic fields created around the current carrying rod having cross sectional area of different shapes. (a_2) Longitudinal view of magnetic field created around the current carrying rod.

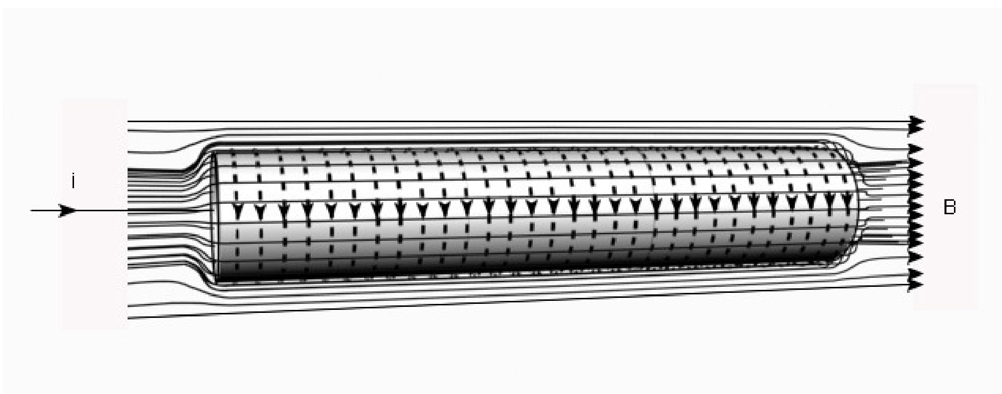
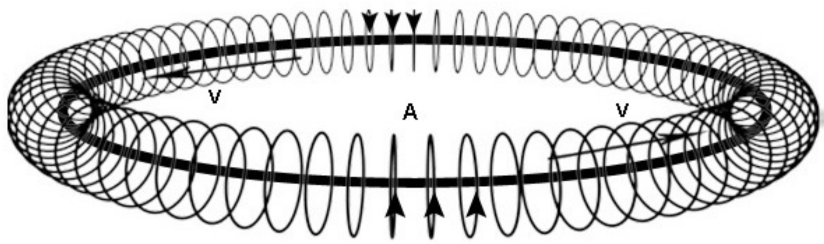
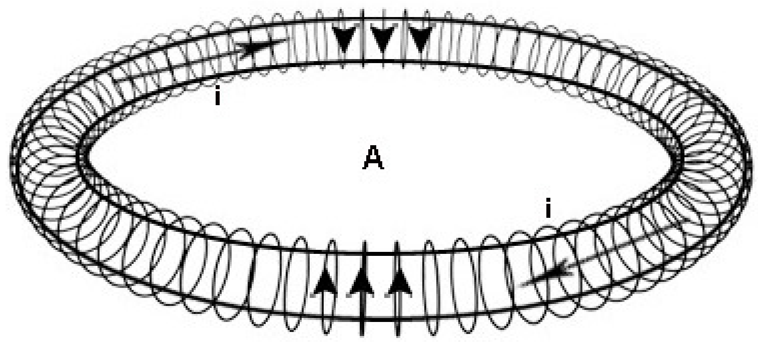


Fig. 11: Longitudinal view of ejection of magnetic lines of force of external magnetic field B from the rod when current *i* starts flowing through the rod.

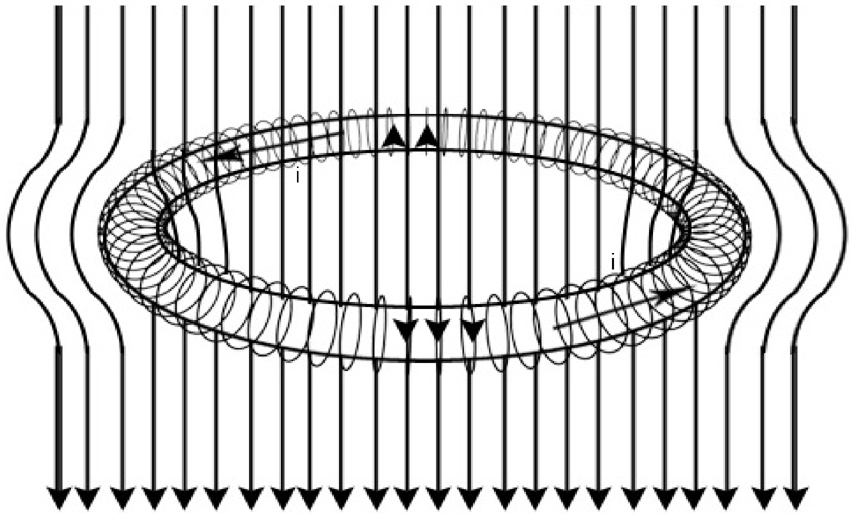


(a)

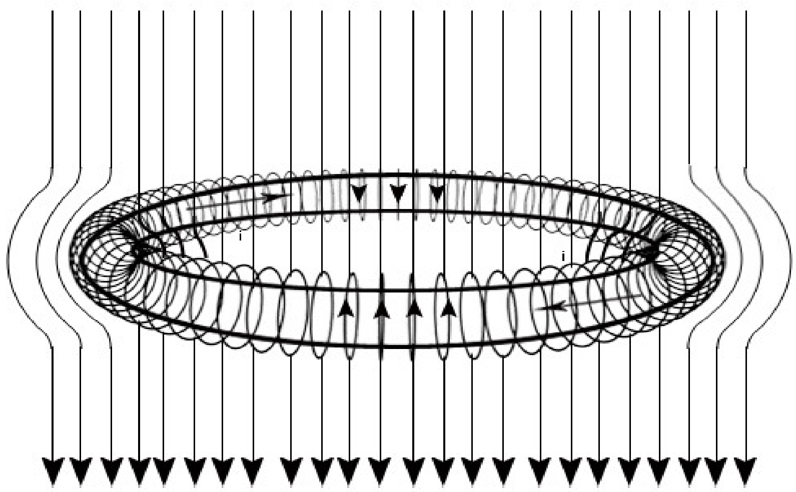


(b)

Fig. 12: (a) Circular rings with arrows round the orbital path of the orbiting electron show the magnetic field generated round the orbit of electron due to its motion with velocity v in the direction of arrows shown along the orbital path of electron. (b) Circular rings with arrows round the thickness of the close loop show the magnetic field generated round the close loop due to the current *i* flowing through it in the direction of arrows shown along the length of the loop.



(a)



(b)

Fig. 13: Deformations in the magnetic lines of force of interacting external magnetic field and the field generated around the closed loop placed in a plane perpendicular to the direction of that external magnetic field (a) when the current i flowing through the loop, shown by long arrows inside the loop, is in a anticlockwise direction, (b) when the current i flowing through the loop, shown by long arrows inside the loop, is in a clockwise direction.