UNDERSTANDING ELECTROMAGNETISM: A NEW APPROACH

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Presently, determining the true cause as to why the phenomenon of electromagnetism takes place, a new theory has been proposed. Consequently, the present theory gives very clear and complete explanation of as to how electromagnetism is generated in electric current carrying rods, which type of magnetism is generated, how a magnetic field is generated around the rods, which occurs in a plane perpendicular to the direction of flow of current through the rods, and how that field possesses direction. Currently, no explanation is found anywhere as to how the above phenomena/events take place. Applying the present theory, some more phenomena too have been tried to explain, which currently though have been explained but are not clear and complete and give rise to numerous fundamental questions.

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1. INTRODUCTION

We observe that as soon as electrons start flowing in their beams or through the electric current carrying rods, an electromagnetism is generated in those and a magnetic field is also simultaneously generated around and along their length in a plane perpendicular to the direction of flow of electrons through those. That field possesses direction, i.e. anticlockwise (if the direction of flow of electrons in their beams or through the rod is towards the face of clock). But currently no explanation is found of any of the above phenomena/event anywhere.

We further observe that in electron beams, the electrons are held together in their respective beams despite repulsive Coulomb force generated between those due to interaction between their charges. It means, between electrons, there is generated a force of attraction too, stronger than the repulsive Coulomb force generated between those due to interaction between their charges. The generated force of attraction keeps electrons bound together in their beams against the repulsive Coulomb force. But currently no explanation is found anywhere as to why and how this attractive force is generated?

All the above observations lead to conclude that since the generation of force of attraction between electrons in their beams, generation of electromagnetism in electron beams and in current carrying rods and generation of magnetic fields around those etc. all take place simultaneously, it means, the cause behind the occurrence of all the above phenomena/events is common/same. But what is that cause, is yet not known.

Currently it is believed that the generation of electromagnetism in electron beams and electric current carrying rods and the generation magnetic field etc. around those take place due to the flow of charge of electrons through those. It is true that the above phenomena/events take place when the electrons start flowing in their beams and through the current carrying rods but it cannot be true that the above phenomena/events take place

due to the flow of charge of electrons because magnetism and magnetic fields etc. can never be generated due to charge of electrons, whether the electrons are moving or stationary. Secondly, as soon as the electrons start flowing in their beams and through the current carrying rods, a force of attraction is also generated simultaneously between their electrons which keep their electrons bound together against the repulsive Coulomb force generated between those due to similar charge on those. Can this force of attraction be generated too due to the charge of electrons? No.

Currently it is also believed that due to spin motion of charge of electron, the electron possesses magnetic field and spin magnetic moment (μ_s)

$$\mu_s = (-e/2m)\, L_s \qquad \text{.....} \qquad (1)$$

[where $-e$ and m respectively are the charge and mass of electron and L_s is its spin angular momentum].

And due to the orbital motion of charge of electron, there are generated a magnetic field around the orbital path of electron and orbital magnetic moment (μ_l)

$$\mu_l = (-e/2m)\, L_l \qquad \text{.....} \qquad (2)$$

[where L_l ($= m\,\mathrm{v}\,\mathrm{r}$, where r is the radius of the orbit and v is the tangential speed of electron) is orbital angular momentum of electron about the axis of rotation around its orbit].

But this belief too cannot be true because it gives rise to numerous very basic and fundamental questions. For example:

1. How and from where does the electron obtain spin motion and how does that (spin motion) persist?

2. The charge of electron, which possesses an electric field around it by the virtue of nature, how can it possess a magnetic field too because of its spin motion? Can it be

possible that a ball of charge which possesses an electric field around it by the virtue of nature, if that ball of charge is made to spin, a magnetic field is also generated around that ball of charge? Supposing if a magnetic field is also generated, do these (electric and magnetic fields) interact with each other or not? If interact, what does happen, and if not, why and how those do not interact?

3. Can the charge of electron generate μ_s, μ_l 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?

4. Supposing if the two fields (1st and 2nd) are generated simultaneously, then during the orbital motion of electron, the 1st magnetic field (generated around the electron) shall have to go on passing through the 2nd magnetic field (generated around the orbital path) continuously. But can it be possible? And if possible, what will happen when the 1st magnetic field passes through the 2nd magnetic field? If not possible then what does happen?

Electron cannot have μ_s and magnetic field around it due to spin motion of its charge or by any means unless it has magnetism by the virtue of nature similarly as it cannot have electric field by any means unless it has charge by the virtue of nature. Similarly, electron cannot have μ_l and magnetic field around its orbital path too.

In addition to the above faults, when the classical result of μ_s was compared to the measurement, it was found off by a proportional factor g and therefore the expressions (1) and (2) were corrected multiplying respectively with correction factors g_s and g_l as

$$\mu_s = g_s(-e/2m)L_s \quad \text{.....} \quad (3)$$

and $$\mu_l = g_l(-e/2m)L_l \quad \text{.....} \quad (4)$$

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

And as in expression (3), μ_s is related to L_s, and in expression (4), μ_l is related to L_l, similarly the total magnetic dipole moment (μ_j) resulting from both spin and orbital angular momentum of electron is related to total angular momentum $L_j = L_l + L_s$ by

$$\mu_j = g_j(-e/2m)L_j \quad \text{..... (5)}$$

where the g factor, i.e. 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 experimentally been determined, which is equal to $2.00231930419922 \pm (1.5\times10^{-12})$. 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 on the name of spin orbit interaction, to determine μ_j as $\boldsymbol{\mu_j}$ = (-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) = ($\boldsymbol{\mu_s} \pm \boldsymbol{\mu_l}$) is neither judicious nor meaningful. Because expression L_j = jh /2π [= (s ± l) h/2π = $L_s \pm L_l$] 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. Secondly, since μ_s is magnetic moment of electron which acts in direction opposite to the direction of L_s, and L_s acts along the perimeter of the orbit tangentially at its every point (see Sec. 5.1), μ_s acts in the plane of orbit, while μ_l is magnetic dipole moment of the orbit of electron and acts along the axis of the orbital motion of electron, i.e. normal to the plane of the orbit and through its centre, then how can their vector sum be taken? Suppose if their vector sum somehow 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 accordingly as the requirements demand in order to obtain the desired results. These have neither any physical significance nor any physical interpretation. Furthermore, the assignment of two values (1/2 and –1/2) to s cannot be true. Because electron spins always in a plane perpendicular to the direction of its orbital velocity and in clockwise direction (see Sec. 5.1), 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.

Now, when: i. The determination of μ_j is neither judicious nor meaningful; ii. The expression L_j = jh /2π is not true; iii. j (= s ± l) can have only one value corresponding to each value of l, not more than one value; the existing explanation of fine structure of spectral lines cannot be true.

The present theory gives very clear and complete explanation of as to why and how the fine structures of spectral lines, variations in their (fine lines) numbers, frequencies and intensities etc. take place (see Sects. I, J and K, Ref. 1) without taking any account of expressions (3) and (5), quantum numbers s, l, j, selection rules, and g factor etc.

Because, presently that cause (mentioned above) has been determined (see Sec. 2), and taking account of that cause, the present theory has been developed (see Sec. 3). The present theory gives very clear and complete explanation as to how the force of attraction is generated between electrons (see Sec. 4.1, Ref. 1), how electromagnetism is generated in electron beams (see Sec. 5, Ref. 1) and current carrying rods (see Sec. 4.1 onwards), which type of magnetism it happens to be (see Sec. 5, Ref. 1 and Sec. 4.2 onwards), how magnetic fields is generated around those in a plane perpendicular to the direction of flow of electrons through those and how that field possess anticlockwise direction (see Sec. 5, Ref. 1 and Sec. 4.1 onwards).

2. DETERMINED CAUSE

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

The magnetism and charge of electron spin in directions opposite to each other because then their respective fields interact (electromagnetic interaction) with each other such that their spin motion in directions opposite to each other persists, and it keeps

electron going on spinning persistently. (For detail and justification of its truth, see Sec. 3, Ref. 2.)

3. THE PRESENT THEORY

The spin motion of electrons generates two very important properties in these (see Sects. 3.1 and 3.2). And further, since the electrons possess magnetism, due to interaction between their magnetic fields, a strong, short range and charge independent force is also generated between these (see Sec. 3.3).

3.1 First property

The spin motion of every particle generates the tendency of linear motion in it along the direction of its spin angular momentum L_s (for verification of its truth, see Sec. I B, Ref. 3). Consequently, every spinning particle, e.g. electron, nucleon etc. possesses direction of its linear motion. By some means, e.g. applying some external field like electric or magnetic field on electrons, protons etc, if the particle is made able to move, the direction of L_s of the particle is oriented and aligned in the direction according to Lorentz force and then it starts moving along the directions of its L_s (for confirmation that the direction of L_s, i.e., the direction of motion of electron is oriented and aligned if electric or magnetic field is applied across this,, see Sec. 4.4 onwards and also Sec. 5.4.1, Ref. 4).

3.2 Second property

If the frequency of spin motion of particle increases by some means, a stage comes when the particle starts moving itself along the direction of its L_S. Then, as the frequency of spin motion of particle increases, the velocity of particle, e.g., electron, proton etc. goes on increasing in accordance to expression[3]

$$v^2 = h\omega / m \quad \ldots\ldots\ldots\

of particle and h is Planck's constant, and for verification of the truth of expression (6), see Sec. I A, Ref. 3].

Due to spin motion, the particle obtains spin energy ($E_s = h\omega/2$, for detail, see Sec. II, Ref. 3) and spin momentum ($p_S = h\omega/\mathrm{v}$, for detail, see Sec. II, Ref. 3) similarly as it obtains linear momentum (p_{lin}) corresponding to its kinetic energy (E_k). For verification of the truth of p_S , we can see Sec. I C, Ref. 3, and also can take the example of photons, where $h\nu/c$, which is currently defined as momentum of photons, is in fact p_S of photons (for its confirmation and detail information, see Sec. 2.2, Ref. 5). It (p_S) is generated due to spin motion of photons which (spin motion) they derive from the orbiting electrons from which they are emitted (for confirmation of its truth, see Sec. I A, Ref. 3).

Therefore, the particles possessing linear motion together with their spin motion, those possess motional energy (E_m) = $E_k + E_s$, and motional momentum (p_m) = $p_{\mathrm{lin}} + p_S$, and whenever comes the situation of conservation of energy and momentum of such particle (i.e. possessing spin motion along with its linear motion), E_m and p_m of particle actually conserve, not its E_k and p_{lin} (for verification of the truth of conservation of p_m , see Sec. I D, Ref. 3).

3.3 The force that is generated between electrons due to interaction between their magnetic fields

Since the electrons possess magnetism, and hence when the current starts flowing the generated two properties in electrons enable these to create such situation that due to interaction between their magnetic fields, a short range, charge independent and very strong force is generated between these (how that force is generated, see Sec. 4.1, Ref. 1).

4. EXPLANATION OF ELECTROMAGNETIC PHENOMENA/EVENTS

4.1 Explanation of how electromagnetism is generated in the current carrying rod, how magnetic field is generated around the rod in a plane perpendicular to the direction of flow of current through it, and how that field possesses direction

Since inside of all the substances, the emission of photons from their orbiting electrons goes on, inside the specimen rod too, the emission of photons from its orbiting electrons goes on. The emitted photons go on travelling here and there inside the specimen rod before those are emitted out from the rod. Then obviously, during their travel inside the specimen rod, those collide with the free electrons of the rod found in their way. Hence, when no voltage is applied across the ends of the rod to make flow of current through it, due to collisions of photons, the directions of L_s (i.e. the directions of motion) of the free electrons of the rod are found randomly oriented in all the different directions of the rod.

And when some electric field is applied across the ends of the rod, due to having two properties (see Sects. 3.1 and 3.2) generated in electrons, the randomly oriented directions of L_s of the free electrons of the rod are oriented and aligned parallel to the direction of the applied electric field (for confirmation of its truth, see Sec. 4.4) and those start moving (flowing) along the direction of their L_s, i.e. parallel to the direction of the applied electric field. The applied electric field does not let the alignment of L_s of electrons be disturbed due to collisions with the photons existing and moving here and there inside the rod. When the directions of L_s of electrons are oriented and aligned, the directions of μ_s of electrons are also oriented and aligned parallel to the direction of electric field but opposite to the direction of alignment of L_s of electrons. And the planes of their magnetism and magnetic fields are oriented and aligned in a plane perpendicular to the direction of the applied electric field, or can say perpendicular to the direction of flow of electrons.

But, through the current carrying rod when the electrons start flowing, those flow through different inter-lattice passages of the rod. Then obviously, the electrons would be flowing through every inter-lattice passage of the rod in the form of number of queues. The flow of electrons in the form of number of queues through every inter-lattice passage can be assumed as, through every inter-lattice passage the electrons are moving in the form of a beam, as shown in Fig. 2. Due to the applied electric field, since the directions of L_s, μ_s and the planes of magnetism and magnetic field of electrons are oriented and aligned, the so called beams obtain all the properties, i.e. electromagnetism, μ_s, magnetic field etc. which the electron beams possess (see Sec. 5, Ref. 1). Therefore, the magnetic fields generated around the so called beams passing through inter-lattice passages, say 1, 2, 3, 4,……. interact as shown in Fig. 2, similarly as magnetic fields around electrons interact, as shown in Fig. 5 and explained in Sec. 5, Ref. 1. Consequently, a force of attraction is generated between all the so called beams and those (beams) are bound together, electromagnetism is generated in the rod and magnetic field is generated around and along the length of the rod in a plane perpendicular to the direction of motion of electrons in the rod, similarly as a force of attraction is generated between all the electrons of an electron beam and the electrons are bound together in their beams, electromagnetism is generated in the beam and magnetic field is generated around and along the length of the beam in a plane perpendicular to the direction of motion of electrons in the beam (see Sec. 5, Ref. 1). Further, since the magnetic field of all the electrons and beams possess spin motion in anticlockwise direction (if the electrons are moving towards the face of the clock), the generated magnetic field around and along the length of the rod too possesses anticlockwise direction.

If the transverse cross-section of the specimen rod is of a circular type, the transverse cross-section of the magnetic field generated around and along the length of the

rod shall also be of circular type, as shown in Fig. 3(a_1 and a_2). [In Fig. 3(a_2), the lines of force, shown by vertical circles round the rod, each circle is in fact consisting of several co-centric circles, but not shown in Fig.] If the rod is quite thick and has a rectangular or square type of transverse cross-section, the transverse cross-section of the magnetic field generated around and along the length of the rod may be of rectangular or square type respectively, Figs. 3(b) and 3(c).

4.2 Explanation of which type of magnetism (electromagnetism) is generated in the rod

It is believed that diamagnetism generated in specimen is a property generated due to its (specimen) free electrons, and as we see too above in Sec. 4.1 and in Sec. 5, Ref. 1 that the electromagnetism is generated in current carrying rods and electron beams due to their free electrons, the generated electromagnetism in them should be diamagnetism.

Further, we observe that when some electric current is allowed to flow through a specimen rod at its normal state and when some persistent current starts flowing through the specimen rod at its superconducting state, in both the cases, magnetism is generated in the rod. When in both the cases, magnetism is generated in the specimen rod, and it is generated due to the same cause, i.e. due to flow of current through the specimen rod, the generated magnetism in both the cases should be of same type. But it is believed that when persistent current starts flowing through the specimen rod at its superconducting state, diamagnetism is generated in the specimen rod. Therefore, the generated magnetism in the specimen rod at its normal state should also be diamagnetism (for its experimental confirmation, see the Sec. 4.3).

4.3 Experimental confirmation that the magnetism (electromagnetism) generated in the current carrying rod is diamagnetism

Let us 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 electric current is allowed to flow through the rod, a kick in the galvanometer reading is observed, which means that some magnetism has generated in the rod and due to that a change of flux has taken place.

If, we take the specimen rod in the form of a close loop and it is brought down to its transition temperature T_c (a 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 shall be observed, which means some magnetism has generated in the specimen and due to that a change of flux has taken place. The magnetism generated in the specimen at its transition temperature happens to be diamagnetism (see Meissner effect[6,7]); therefore, the magnetism generated in the current carrying specimen rod should also be diamagnetism.

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

If we take an iron bar and place it in the earth's magnetic field parallel to the direction of the earth's magnetic field; we find no change in the lines of force of the earth's magnetic field near the bar. The lines of force of the earth's magnetic field, which were earlier passing through the space where now the bar has been placed, pass through the bar. But if, after magnetising the iron bar or a similar bar magnet is placed in the same position of the earth's magnetic field such that its north pole lies towards the magnetic north pole of the earth's magnetic field and vice versa, we find that the magnetic lines of force of the earth's magnetic field, which were earlier passing through the bar when it was not magnetized, are now expelled out from the bar. The expulsion of magnetic lines of force of

the earth's magnetic field from the bar takes place because when the bar is magnetized, its lines of force are generated, and according to the property of magnetic lines of force, since magnetic line of force neither intersects itself nor other lines of force, the lines of force of the earth's magnetic field are expelled out from the bar in order to avoid intersection.

Similarly, when the lines of force of external magnetic field are expelled out from the specimen as a current starts flowing through it (previous experiment, Sec. 4.3), it means, some magnetic lines of force are generated in the specimen, which are so oriented and aligned that those block the lines of force of external magnetic field (i.e. the magnetic field generated around the steady current carrying primary coil) to pass through the specimen, consequently those are expelled out from the specimen as shown in Fig. 4 (if the specimen is in the form of a straight rod). The lines of force, which block the lines of force of the external magnetic to pass through the specimen, do not come from outside but are created when the current, or can say the free electrons of the specimen start flowing through it. It means, since the electrons possess magnetic field, their magnetic fields are oriented and aligned such that those block the lines of force of the external magnetic field to pass through the specimen. Other than electrons, there exists no source, which possesses magnetic field and whose magnetic field can be set responsible for blocking the external magnetic field.

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

4.5 Important conclusion

The magnetic moment of electron (μ_s) and the magnetic moment of current carrying rod are actually the magnetic moments, not the magnetic dipole moments, and (μ_s) is defined too always as magnetic moment, never as magnetic dipole moment. Because, by convention, the magnetic dipole means, the magnet 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 magnets, where, through their south poles, their magnetic lines of force enter the bar magnets and through their north poles, their magnetic lines of force exit out from the bar magnets. Similarly the electronic orbits see Sec. 5.1 and Fig. 5(a), and the current carrying close loops, see Sec. 5.2 and Fig. 5(b), where, through their south poles, the lines of force of their magnetic fields enter and through their north poles, the lines of force of their magnetic fields exit. While the magnetic lines of force of electron, Fig. 1, and current carrying rod, Fig. 3(a_2), do not enter and exit out from those, consequently no poles are created.

5. EXPLANATION OF SOME OTHER PHENOMENA RELATED WITH ELECTROMAGNETISM

5.1 Explanation of how electron orbits behave like magnetic dipoles and their magnetic north and south poles are created

Since the electron moves along the direction of its L_s, and hence when it moves with velocity v along its orbit, marked by two long arrows in Fig. 5 (a), the direction of its L_s happens to be aligned along its orbital path (tangentially at its every point) and the planes of its magnetism and magnetic field happen to be aligned in a plane perpendicular to the orbital path, shown by circular vertical rings round the orbital path in Fig 5(a). [In Fig. 5(a), each circular vertical ring round the orbital path is in fact consisting of several co-

centric circles, but not shown in Fig.] And the direction of spin motion of its magnetism and magnetic field happens to be anticlockwise (if the direction of motion of electron along its orbital path is towards the face of clock), shown by arrows along the circular vertical rings in Fig. 5(a). Now if we look at Fig. 5(a), we find that the lines of force of magnetic field generated round the orbital path enter the empty space A through the upper surface of the orbit, and after exit from the lower surface of the orbit, turning round the orbit those reach again towards the upper surface of the orbit to enter through it. By convention, since it is assumed that the space near the surface of a dipole through which its magnetic lines of force enter, behaves as the south (S) pole, and the space near the surface from which the magnetic lines of force of the magnetic dipole exit, behaves as the north (N) pole, the upper surface of the orbit behaves as the south pole and lower surface as the north pole. To this dipole, the magnetic dipole moment μ_l is associated.

5.2 Explanation of how current carrying closed loops behave like magnetic dipoles and their magnetic north and south poles are created

In the manner a magnetic field is generated around the current carrying rod (see Sec. 4.1), in the same manner a magnetic field is also generated if the rod is taken in the form of a close loop and that is obtained as shown in Fig. 5(b). [In Fig. 5(b), each circular vertical ring round the close loop is in fact consisting of several co-centric circles, but not shown in Fig.] If we look at Fig. 5(b), we find that the lines of force of the magnetic field generated round the current carrying closed loop enter the empty space A through the upper surface of the closed loop, and after their exit from the lower surface of the orbit, turning round the closed loop those reach again towards the upper surface of the closed loop to enter through it. By convention, since it is assumed that the space near the surface of a dipole through which its magnetic lines of force enter, behaves as the south (S) pole, and the space near the surface from which the magnetic lines of force of the magnetic dipole exit, behaves as

the north (N) pole, the upper surface of the closed loop behaves as the south pole and lower surface as the north pole.

5.3 Discussion

Currently, no explanation is found as to how the electronic orbits and current carrying closed loops behave like magnetic dipoles and how their two magnetic poles are created. Currently it is merely being assumed that as due to flow of charge of electrons through the current carrying rod a magnetic field is generated around it, similarly due to flow of charge of electron during the motion of electron along its orbit and due to flow of charge of electrons along current carrying closed loops, magnetic fields are generated around those and those behave as magnetic dipoles. But this assumption cannot be accepted because for electronic orbits and current carrying loops to behave as magnetic dipoles, it is necessary that the magnetic fields generated around those must occur in manners as shown in Figs. 5(a) and 5(b), and the current assumption fails to explain it.

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FIGURE CAPTIONS

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.

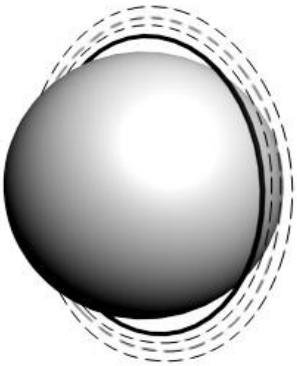
Fig. 2: (a), (b), and (c) Transverse cross sectional view of interaction between the magnetic fields generated around electron beams (formed due to motion of electrons in number of queues through different inter-lattice passages) while moving parallel to each other in the same direction with the same velocity v. Very small solid dark disks represent the positions of lattices in the specimen

Fig. 3: (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.

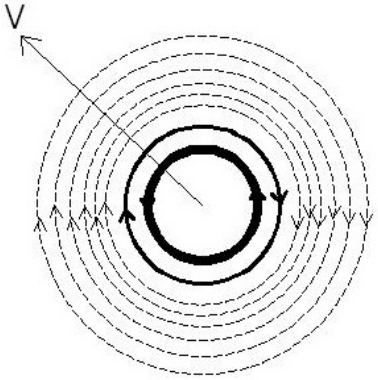
Fig. 4: Longitudinal view of ejection of magnetic lines of force of external magnetic field B from the rod when the current *i* starts flowing through the rod.

Fig. 5: (a). Longitudinal view of magnetic field generated around and along the length of electronic orbit. Circular vertical rings with arrows round the orbit show the magnetic field generated around the orbit, and arrows represent its (magnetic field) direction. The two long arrows along the length of orbit represent the direction of velocity v of electron along its orbit. (b). Longitudinal view of magnetic field generated around and along the length of current carrying rod taken in the form a close loop. The vertical rings with arrows represent the lines of force of the generated magnetic field, and arrows represent its (magnetic field)

direction. The two long arrows along the length of loop represent the direction of flow of current i through the loop.

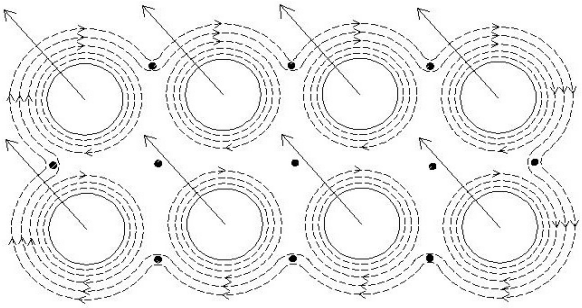


(a)

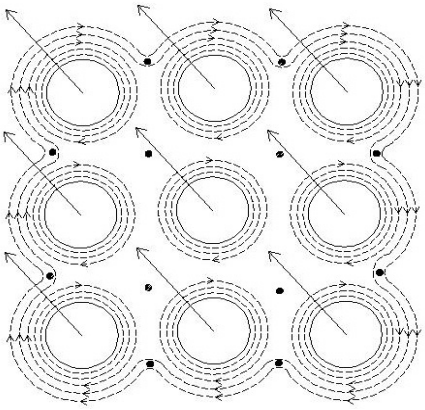


(b)

Fig. 1



(a)



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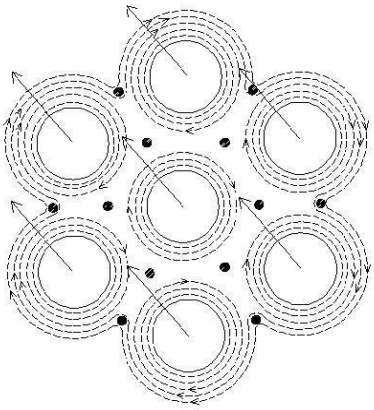
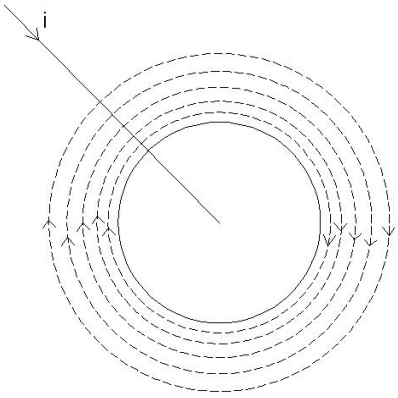
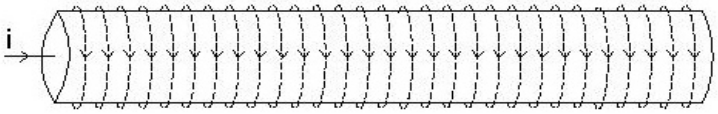


(c)

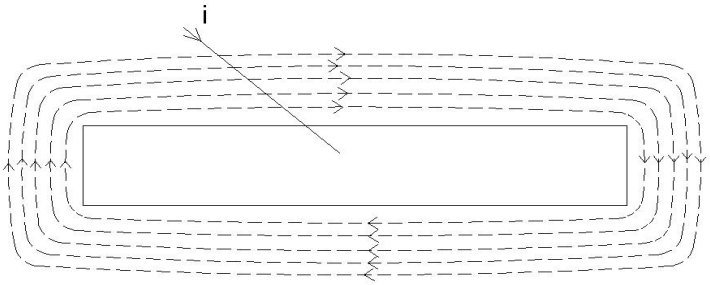
Fig. 2



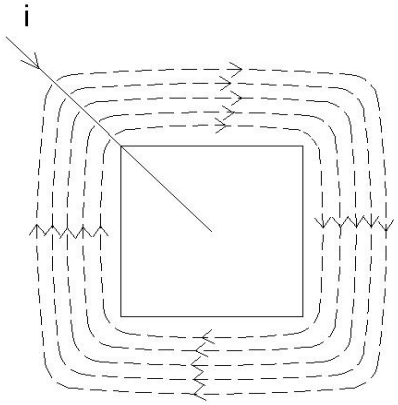
(a_1)



(a_2)



(b)



(c)

Fig. 3

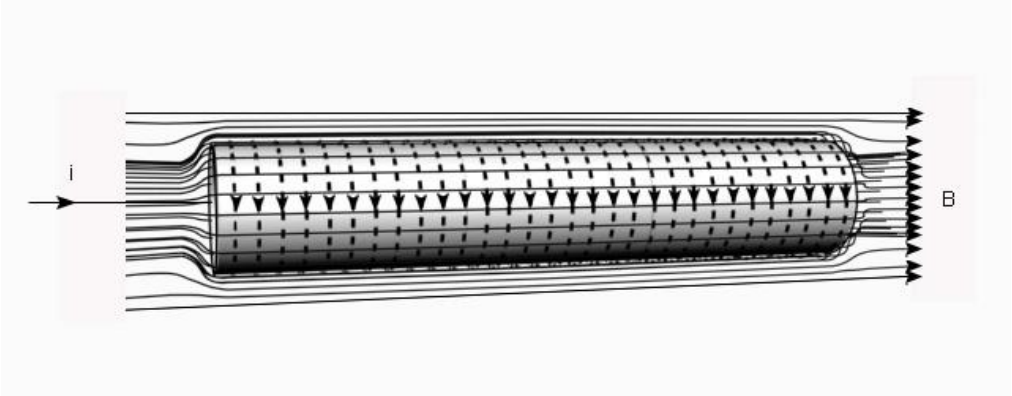
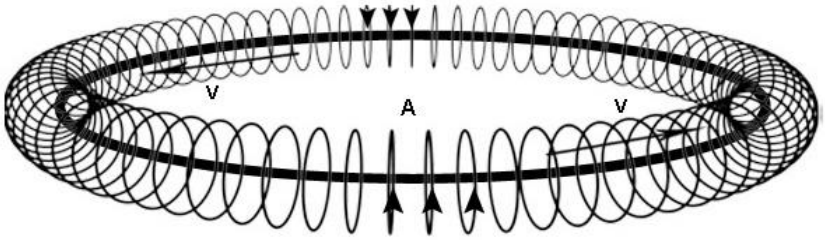
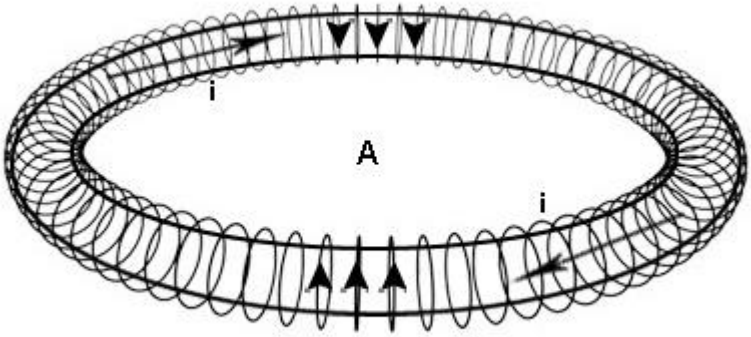


Fig. 4



(a)



(b)

Fig. 5