UNDERSTANDING SUPERCONDUCTIVITY: A NEW APPROACH

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Presently, determining the true cause as to why superconductivity is generated, a new theory has been propounded. Consequently, the present theory gives very clear and complete understanding as to how superconductivity and properties, effects etc. exhibited by superconductors are generated. Presently, it has also been tried to explain as to how currently known some non-superconducting (e.g. ferromagnetic) substances can be made superconducting. Currently, to explain as to how superconductivity and properties, effects etc. exhibited by superconductors are generated, several theories have so far been proposed. For BCS (Bardeen–Cooper–Schrieffer) theory it is claimed that it provides better quantum explanation of superconductivity and accounts very well for all the properties exhibited by the superconductors. This claim is true but if we examine the BCS theory and its rigorous mathematical proofs closely and intently, we find that it is based on such concepts which are practically not possible and contradict two well-observed facts. Further, it gives rise to several very basic and fundamental questions too.

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1. INTRODUCTION

We observe that if an electric voltage is applied across a specimen rod at its normal room temperature, a current starts flowing through the rod, and as soon as the current starts flowing through the rod, the rod is simultaneously diamagnetized too (for its confirmation, see Sects. 4.2 and 4.3, Ref. 1). And if instead of applying an electric voltage across the specimen rod, taking the specimen rod in the form of a close loop (otherwise current cannot flow persistently through the specimen), the specimen is cooled down to its transition temperature (T_c) keeping it in some external magnetic field of appropriate strength (as is being done), a persistent current starts flowing through it, and as soon as the persistent current starts flowing, the specimen is simultaneously diamagnetized too. At temperature T_c, the current flows itself and persistently without any external aid while at normal room temperature, an external aid is needed otherwise the current does not flow, and as soon as that external aid is removed, the current stops flowing. These observations lead to conclude:

1 At temperature T_c of specimen, some obstacle(s) which was earlier, i.e. at temperatures $> T_c$ resisting the motion of electrons and not letting them to move freely without any external aid, vanishes.

2 Electrons possess some cause that generates linear velocity in those and keeps those going on moving persistently for indefinitely long time even against the gravitational force acting on those if those are not resisted and are let free to move.

3 There occurs some source/means that orients and aligns the directions of linear velocity of electrons of the specimen in one direction, and as soon as at temperature T_c of specimen the obstacles disappear from it and the passage of electrons becomes resistance-less, the orientation and alignment of the directions of linear velocity of electrons of the specimen starts persisting and flow of persistent current is obtained.

4 Electrons possess some magnetism, and it (magnetism of electrons) occurs in such a form and manner that as soon as electrons start flowing, their magnetism are arranged, or can say oriented and aligned in such a manner that a diamagnetism is also generated simultaneously. (Otherwise, diamagnetism cannot be generated simultaneously as soon as the electrons start flowing, and cannot be vanished simultaneously as soon as electrons stop flowing.)

Without determining: i. What is obstacle that resists the motion of electrons at temperatures $> T_c$, and vanishes at temperature T_c; ii. What is cause that generates linear velocity in electrons and keeps them going on moving persistently; iii. What is source/ means that orients and aligns the directions of linear velocity of electrons in one direction; iv. How and in which form and manner the electrons possess magnetism such that as soon as those start flowing, diamagnetism is generated, and as soon as those stop flowing, diamagnetism vanishes; no true theory can be developed to explain as to how superconductivity and properties, effects etc. exhibited by superconductors are generated.

To explain as to how superconductivity and properties effects etc. exhibited by superconductors are generated, several theories have so far been proposed. For BCS (Bardeen–Cooper–Schrieffer) theory[2,3] it is claimed that it provides better quantum explanation of superconductivity and accounts very well for all the properties exhibited by the superconductors. But none of these theories has been developed taking account of the factors pointed out above.

The BCS theory no doubt provides better quantum explanation of superconductivity and accounts very well for all the properties exhibited by the superconductors. But if we examine the BCS theory and its rigorous mathematical proofs closely and intently, we find that it is based on such concepts which are practically not possible and contradict two well-observed facts too (for detail, see Sec. 6). These concepts have been chosen keeping in view that these may give the desired results. No thinking has been focused over whether these are logically and/or practically possible or not. Consequently these concepts give rise to numerous very basic and fundamental questions (see Sec. 6). But instead of realizing the truth, several assumptions have further been taken in order to justify the chosen concepts (see Sec. 6). These assumptions too are not true and give rise to numerous more very basic and fundamental questions (see Sec. 6). Most importantly, the taken assumptions cannot be avoided otherwise the BCS theory fails to give the desired results.

Secondly, the BCS theory does not explain all the properties exhibited by the superconductors, It fails to explain several very important properties.

Presently, it has been determined: i. What is obstacle that resists the motion of electrons at temperatures $> T_c$, and vanishes at temperature T_c (see Sec.2.1); ii. What is cause that generates linear velocity in electrons and keeps them going on moving persistently (see Sec. 2.3); iii. What is source/means that orients and aligns the directions of linear velocity of electrons (see Sec. 2.4); iv. How and in which form and manner the electrons possess magnetism such that as soon as those start flowing, diamagnetism is generated (see Sec. 2.2). And taking account of all these determined factors, a new theory has been developed. It gives very clear and complete explanation as to how superconductivity, properties and effects etc. exhibited by superconductors take place.

The present theory enables to explain also as to how currently known some non-superconducting (e.g. ferromagnetic) substances can be made superconducting.

2. DETERMINATION OF:

2.1 Obstacle, that resists the motion of electrons at temperatures $> T_c$, vanishes at temperature T_c

We know that when the temperature of any substance decreases, thermal energy of that’s atoms and hence of that’s orbiting electrons goes on decreasing. In this process of decreasing the temperature, a temperature shall positively be obtained when the thermal energy of the orbiting electrons shall be reduced as much that some of them shall become unable to excite to any allowed higher energy state. Then, these orbiting electrons shall stop exciting and hence emitting photons. Since the innermost orbiting electrons require maximum energy for their excitation because of having maximum binding energy, those shall stop exciting and emitting photons first. If the temperature of the substance is reduced further, the thermal energy of the comparatively outer orbiting electrons too shall be reduced as much that they shall become unable to excite and emit photons. If we go on reducing the temperature of the substance in this way, a temperature, say T', shall be obtained when the outermost orbiting electrons too shall become unable to excite and emit photons, i.e. at temperature T', all the orbiting electrons of the substance shall become able to excite and emit photons. Then (i.e. at temperature T') the photons present inside the substance start disappearing from it. All the photons are not disappeared from the substance immediately because practically it is not possible. In the, beginning those start disappearing very fast but very shortly, can say at temperature T_c and afterwards, the rate of disappearing of the photons is reduced very much. Then the number of photons is reduced so much that those become unable to disturb the flow of free electrons of the substance.

So, at temperature T_c, when the photons become unable to disturb the flow of free electrons of the substance, the substance can be said to be at resistanceless state, and the temperature T_c can be said to be the transition temperature of the substance. (For confirmation that at T_c, due to disappearance of photons from the specimen, its resistance is reduced to zero, see Sec. 2.1.1)

2.1.1 Evidences to confirm that at T_c, due to disappearance of photons from the specimen, its resistance is reduced to zero.

2.1.1 (a) First evidence

Currently it is believed that at T_c of superconducting substance, its resistance is suddenly reduced to zero. But it is not true. Before arriving at T_c, every superconducting substance arrives at temperature, say T'_c, from where the resistance of the substance suddenly starts decreasing very fast, and at T_c, that reduces to zero, as shown in Fig.1(a). Consequently, the straight line joining points A (at T'_c) and B (at T_c), which shows the rate of fall of resistivity of the substance during decrease in its temperature from T'_c to T_c, Fig. 1(a), is not found to be exactly vertical but is very little inclined. For example, in the case of mercury, Fig. 1(b)[4], where T'_c is nearly 4.25° K (Kelvin) and T_c is 4.2° K, and line AB is not vertical but very little inclined. The inclination of straight line AB varies from substance to substance. (Why and how the inclination of straight line AB varies from substance to substance has been explained onwards, see Sec. 5.2.)

The above complete phenomenon occurs due to the reason that T'_c happens to be actually T', at which (i.e. T') all the orbiting electrons of the substance stop exciting and emitting photons (see Sec. 2.1), and the photons present inside the substance start disappearing from the substance. In the beginning, the disappearance of photons from the substance happens to be very fast, and very shortly a temperature T_c is obtained when their number is reduced so much that they become unable to disturb the flow of free electrons of the substance. Beyond T_c, as temperature of the substance decreases, the disappearance of photons from the substance goes on continuously but the rate of disappearance becomes very-very slow.

So, near T'_c, resistance of the substance starts reducing very fast and very shortly at T_c, that is reduced to zero.

2.1.1 (b) Second evidence

The photons are generated in the specimen as the consequence of application of an external magnetic field H_c across it too (see Sec. 5.7.1), and consequently superconducting state of the specimen destroyed, or can say normal state of the specimen is restored.

If superconducting state of specimen is disappeared as the consequence of production of photons into the specimen, the superconducting state of specimen should be obtained as the consequence of disappearance of photons from the specimen.

2.2 How and in which form and manner the electrons possess magnetism

The current belief that electrons possess magnetism, magnetic field and spin magnetic moment (μ_s) due to spin motion of its charge, is not true (for its confirmation, see Sec. 1, Ref. 1). 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 (for detail, see Sec. 2, Ref. 1). This magnetism occurs in the form of a circular ring, shown by a dark solid line circle around the charge of electron where charge has been shown by a spherical ball, Fig. 2(a), as for example, there occur rings around the planet Saturn. Around the charge of electron, there occurs its electric field (which has not been shown in Fig.), and around magnetism of electron, there occurs its magnetic field shown by broken line circles, Fig. 2(a). The magnetism and charge of electron both spin, but in directions opposite to each other, shown by arrows in opposite directions, Fig. 2(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. (For detail, see Sec. 2, Ref. 1.)

2.3 Cause that generates linear velocity in electrons and keeps these going on moving persistently

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 sustains, which keeps electron going on spinning persistently (for detail and justification of its truth, see Sec. 3, Ref. 5). The cause that generates linear velocity in electrons and keeps these going on moving persistently is their spin motion (for detail, see Sec. 3).

2.4 Source/means that orients and aligns the directions of linear velocity of electrons

The external magnetic field, placing in which the specimen is cooled down to $\leq T_c$, orients and aligns the randomly oriented directions of L_s of the free electrons of the specimen along the direction according to Lorentz force (for confirmation of its truth, see Sec. 5.4.1 onwards)

3. THE PRESENT THEORY

The spin motion of electrons generates two very important properties in these (see Sects. 3.1 and 3.2). And since the electrons possess magnetism too, 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. 6). Consequently, every spinning particle, e.g. electron, nucleons etc. possesses direction of its linear motion. By some means, e.g. applying some external force 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, Ref. 1 and also Sec. 5.4.1 onwards).

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[6]

$$\mathrm{v}^2 = h\omega / m \qquad \text{...(1)}$$

[where m, v and ω respectively are the mass, linear velocity and frequency of spin motion of particle and h is Planck's constant, and for the verification of the truth of expression (1), see Sec. I A, Ref. 6].

Due to spin motion, the particle obtains spin energy ($E_s = h\omega/2$, for detail, see Sec. II, Ref. 6) and spin momentum ($p_S = h\omega/\mathrm{v}$, for detail, see Sec. II, Ref. 6) 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. 6, 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. 7). 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. 6).

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. 6).

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 persistent 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. 8).

4. EXPLANATION OF HOW SUPERCONDUCTIVITY IS GENERATED AT TEMPERATURE *T_c*

At temperature T_c, when the number of photons inside the specimen is reduced so much that those become unable to disturb the flow of free electrons of the specimen, the directions of L_s , i.e. the directions of linear velocity generated in electrons (see the first and second generated properties, Sects. 3.1 and 3.2) of the specimen are found randomly oriented in all the different directions because of frequent collisions with the photons earlier present in the specimen. The external magnetic field, placing in which the specimen is cooled down to $\leq T_c$, orients and aligns the randomly oriented directions of L_s of the free electrons of the specimen in direction perpendicular to its direction according to Lorentz force (for confirmation of its truth, see Sec. 5.4.1 onwards). And as soon as the directions of L_s of the free electrons are oriented and aligned, the electrons start flowing in that direction, i.e. the persistent current starts flowing through the specimen in that direction. This state of specimen is its superconducting state.

Once the directions of L_s, i.e. of linear velocity of electrons are oriented and aligned, that persists and is not being disturbed even after removing the external magnetic field. That can be disturbed only by some external means, e.g., by generating photons again in the specimen rod by some means (see Sec. 5.7.1).

5. EXPLANATION OF PROPERTIES AND EFFECTS EXHIBITED BY SUPERCONDUCTORS

5.1 Explanation of why and how the entropy at superconducting state of the substance decreases

The decrease in entropy at superconducting state of specimen means, the system becomes more ordered, or in other words, the disturbance in the specimen is reduced. At T_c, since all the orbiting electrons of the specimen stop exciting and emitting photons, the disturbance due to their excitation is reduced to zero. And further, at T_c since the number of photons inside the specimen is reduced so much that those become unable to disturb the alignment of free electrons of the specimen due to their collisions with the electrons, then obviously the alignment of electrons persists, i.e. the system becomes ordered. Consequently the entropy of the substance is decreased.

5.2 Explanation of variation of T_c from substance to substance

We know that at same temperature, thermal conductivity varies from substance to substance. It happens so because at same temperature, the number of photons, which conduct the heat (because photons are radiation energy carriers which produce light and heat effects, see Sec. 2.2, Ref. 7), emitted from the orbiting electrons of different substances varies from substance to substance. The variation in emission of number of photons from substance to substance means, the magnitude of binding force by which the orbiting electrons are bound with their respective nuclei in atoms of different substances, varies from substance to substance. Because, suppose in substance S_1, its electrons are loosely bound with their respective nuclei in comparison to electrons which are bound with their respective nuclei in substance S_2, at same temperature, the number of photons emitted from the substance S_1 may be more than the photons emitted from the substance S_2. If atomic number of substance S_1 is more in comparison to that of substance S_2, the number of photons emitted from the substance S_1 may be even more.

When the magnitude of binding force by which the orbiting electrons are bound with their respective nuclei in atoms of different substances, varies from substance to substance, if the temperature of different substances, e.g. S_1, S_2, S_3, of which the binding force by which their orbiting electrons are bound increases as we go from substance S_1 to S_3, is reduced, the temperature T' at which all the orbiting electrons of the substance become unable to excite and emit photons (see Sec. 2.1) shall be obtained earliest for substance S_3, and for substance S_1 shall be obtained in the last, i.e., for substance S_3, T' shall be $> T'$ for substance S_2, and for substance S_2, T' shall be $> T'$ for substance S_1. In other words, temperature T' varies from substance to substance

Since temperature T' happens to be T'_c [see Sec. 2.1.1(a)], T'_c too varies from substance to substance. Further, the substances S_1, S_2, S_3 may have different atomic numbers. Then the rate of production of number of photons in substances S_1, S_2, S_3 shall be different. And during the fall of temperature of the substance from temperature T'_c to T_c [see Sec. 2.1.1(a)], the rate of disappearance of photons from the substance too shall vary from substance to substance. Consequently, slope of straight line AB [see Sec. 2.1.1(a)] and T_c vary from substance to substance.

5.3 Explanation of why and how the substances like Cu and Au etc. do not superconduct even down to very low temperatures

Some substances, e.g. *Cu* and *Au* etc., which are very good conductors of current, do not superconduct even at temperatures down to 0.05 K. If we investigate, we find that these substances are very good conductors of heat too, which means, these are very susceptible to temperature and even a very little change of temperature in it is conducted to the full system (i.e. body).

In conductors, the heat is mainly conducted by transportation which is done by photons because photons are the radiation energy carriers [see Sec. 2.1.1(a), Ref. 7] like electrons which carry charge. In these substances, since even a very little change in temperature is conducted to the full system, the excitation of orbiting electrons of these substances and hence emission of photons from them continues even down to very low temperatures. Therefore, these substances do not become able to get free from photons even at temperatures down to 0.05 K. and consequently do not become able superconduct even down to so low temperatures.

5.4 Explanation of how Meissner effect takes place and how a magnet is levitated above a superconductor

At superconducting state when the directions of L_s of the free electrons of the specimen are oriented and aligned and the persistent current starts flowing (see Sec. 4), obviously the directions of μ_s of electrons are also oriented and aligned but in direction opposite to the direction of orientation and alignment of L_s of electrons. The planes of magnetism and magnetic fields of electrons are also oriented and aligned in a plane perpendicular to the direction of flow of persistent current.

But, through the specimen when the persistent current, i.e. the free electrons of the specimen start flowing, those flow through different inter-lattice passages of the specimen. Then obviously, the electrons would be flowing through every inter-lattice passage of the specimen 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. 3. 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. 8). 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. 3, similarly as magnetic fields around electrons interact, as shown in Fig. 5 and explained in Sec. 5, Ref. 8. Consequently, a force of attraction is generated between all the so called beams and those are bound together, electromagnetism is generated in the specimen and magnetic field is generated around and along length of the specimen in a plane perpendicular to the direction of motion of electrons in the specimen, 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. 8). 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 specimen too possesses anticlockwise direction, or can say clockwise if we consider it with respect to the direction flow of persistent current i (because electrons flow in direction opposite to the direction of flow of i) as shown in Fig. 4. (In the magnetic field generated around and along the length of specimen, the lines of force, shown by vertical circles, each circle is in fact consisting of several co-centric circles, but not shown in Fig. 4.)

Thus, the specimen starts behaving just like a magnetic dipole similarly as an electric current carrying close loop behaves as magnetic dipole (see Sec. 5.2, Ref.1). The upper surface of the specimen starts behaving like magnetic north pole. Consequently, the magnetic lines of force of the external magnetic field, which were earlier passing through the specimen when it had not acquired the superconducting state and no persistent current was flowing through it, are now expelled out from the specimen (i.e. Meissner effect[9,10]). The expulsion of lines of force of the external magnetic field takes place similarly as when a bar magnet is placed in magnetic meridian of the earth's magnetic field with its north pole towards the magnetic north of the earth, the magnetic lines of force of the earth's magnetic field are expelled out from the bar magnet.

If the magnet above the upper surface of the magnetic dipole (i.e. specimen) is laid down on it or suspended near its surface, the magnet is levitated above the dipole because of repulsive force between the north poles of magnetic dipole and magnet**.** It is claimed that the levitation of magnet takes place if the superconductor is a high temperature superconductor. The reason behind it may be that, in high temperature superconductors, due to their high temperature, their free electrons possess more energy and hence more velocity. Consequently, high temperature superconductors possess more persistent current which generates strong magnetic field around those. Therefore, the magnets are levitated if the superconductors are high temperature superconductor.

5.4.1 Confirmation of that, at superconducting state of the specimen the directions of μ_s and L_s of electrons of the rod are oriented and aligned

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 is placed, pass through the bar. But if, after magnetizing the iron bar, we place it 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 earth's magnetic field from the bar takes place because when the bar is magnetized, its lines of force are generated, and according to property of magnetic lines of force, since lines of force neither intersect themselves nor other lines of force, the lines of force of the earth's magnetic field are expelled out from the bar.

Similarly, when the lines of force of external magnetic field are expelled out from the specimen at its superconducting state (see Sec. 5.4), it means, there is generated some magnetic field, the lines of force of which are so oriented and aligned with respect to the direction of lines of force of the external magnetic field that these stop the lines of force of the external magnetic field to pass through the specimen, consequently the lines of force of the external magnetic are expelled out from the specimen as shown in Figs. 5(b). The lines of force, which stop the lines of force of the external magnetic field to pass through the specimen, do not come from outside but are generated within the specimen when the persistent current starts flowing through it. Since the electrons possess magnetic field, and the lines of force are generated within the specimen when the persistent current starts flowing through the specimen, it means, the magnetic fields of electrons of the specimen are oriented and aligned such that the lines of force of the external magnetic field are stopped. Other than this, there is no means by which the generation of magnetic field within the specimen can be possible. And when the magnetic fields of electrons of the specimen are oriented and aligned, obviously the directions of μ_s and L_s of electrons are also oriented and aligned.

5.5 Explanation of why and how diamagnetism generated in substances at their superconducting state persists, while generated at normal state does not persist

In substances at their superconducting state, since the number of photons is reduced so much that the alignment of the directions of μ_s of free electrons of the substance due to the external magnetic field applied to initiate the persistent current starts persisting, the diamagnetism developed in the substances persists. While in substances at their normal state (i.e. at temperatures $> T_c$), since the photons exist there in the substances, due to frequent collisions of photons with the electrons of the substances, the alignment of directions of μ_s of electrons of the substances due to the external magnetic field applied to magnetize the substance (or due to the allowance of electric current to flow through the substance, because it too causes the generation of diamagnetism in the substance, see Sec. 4, Ref. 1) happens to be weak. And hence, it (alignment) does not persist and very shortly it is being destroyed after the removal of the external magnetic field (or after disallowing the electric current to pass through the substance). Therefore, the diamagnetic property in substances at their normal state does not persist and very shortly it disappears.

5.6 Explanation of no occurrence of superconducting state in ferromagnetic substances

We observe that when a current carrying closed loop or coil is suspended freely between two magnetic poles, the loop/coil is rotated such that its south and north poles may lie towards the north and south poles respectively of the external magnetic field. The angle of rotation of loop/coil depends upon the strength of current flowing through the loop/coil, strength of external magnetic field and also upon how much loop/coil is free to rotate.

Since the electronic orbits of substance also behave like magnetic dipoles, if a specimen is placed in an external magnetic field, its orbits are rotated and their rotations depend upon how much the orbits are free to rotate and upon the strength of the external magnetic field. In accordance as the orbits of the specimen are rotated, the specimen acquires magnetism.

In ferromagnetic substances, the electronic orbits are probably so arranged in different planes and with different magnitudes of binding in their respective atoms such that when ferromagnetic substances are placed in an external magnetic field, their orbits are rotated, or better to say oriented significantly and in such a way that the resultant magnetism generated in those due to their (orbits) rotations are obtained to be quite strong. (In non-ferromagnetic substances too, which superconduct, their electronic orbits would be rotating as the consequence of application of external magnetic fields across those, but due to rotations of electronic orbits of such substances, the resultant magnetisms generated in these are happened to be either insignificant in magnitude or insignificant in producing the effective obstruction in the orientation and alignment of μ_s and L_s etc. of their free electrons at their T_c .)

The direction of magnetic moment of magnetism generated in ferromagnetic substance due to orientation of its electronic orbits lies along the direction of external magnetic while the directions of μ_s of free electrons of the substance lie in direction perpendicular to the direction of external magnetic, the magnetism generated in ferromagnetic substance opposes the orientation and alignment of μ_s of electrons of the specimen rod and does not let μ_s of electrons to get oriented and aligned. Then L_s of electrons too are not oriented and aligned and consequently electrons fail to flow through the rod. Therefore, in ferromagnetic substances, superconducting state does not occur.

5.6.1 Important conclusions:

Currently known some non-superconducting substances, e.g. ferromagnetic substances (where due to generation of magnetism in the substances because of orientation of their electronic orbits, superconducting state fails to occur) can be made superconducting.

By some means, other than the application of external magnetic field, if it is tried to orient and align the directions of L_s of electrons, magnetism shall not be generated in the specimen due to orientation of its electronic orbits. Then the directions of L_s of electrons of the substance can be oriented and aligned and by this means ferromagnetic substances can be made superconducting.

The means, other than external magnetic field, which can orient and align the directions of L_s of electrons, can be the application of appropriate electric voltage across the specimen (for its confirmation, see Sec. 4.4, Ref. 1). We take the close loop of specimen and couple its two ends by a weak link which can consist of a thin insulating barrier. The thin insulating barrier should be such that when at normal state, loop is connected in a electric circuit, the thin insulating barrier produces resistance in the circuit, and when brought down to superconducting state and its resistance becomes zero, M.E. and M.M. of its free electrons may enable electrons to transmit through the thin insulating barrier (as happens in the case of Josephson's Tunneling, see Sec. 5.10). We connect this loop in an electric circuit containing a battery, ammeter and a load, i.e. a voltage is applied across the weak link. If this loop is cooled down, as soon as T_c of the specimen is obtained, the resistance of specimen shall become zero. Then the directions of L_s of the free electrons of the loop shall be aligned, and due to having M.E. and M.M., the free electrons shall pass through the insulating barrier. And consequently a sudden increase in current through the circuit shall be observed. Now if the circuit is broken, the flow of persistent current shall not be affected and it shall go on flowing persistently.

5.7 Explanation of how normal state of specimen is restored applying an external magnetic field H_c across it at its superconducting state, why H_c increases as temperature of specimen decreases beyond its T_c, and why H_c varies from substance to substance.

5.7.1 How normal state of specimen is restored applying an external magnetic field H_c across it at its superconducting state.

The normal state of specimen is restored applying an external magnetic field H_c across it at its superconducting state means, the cause, i.e. disappearance of photons from the specimen due to which the superconducting state had been obtained, is destroyed, i.e. the generation of photons in the specimen is started as the consequence of applying an external magnetic field H_c across the specimen at its superconducting state.

The generation of photons as the consequence of application of external magnetic field can be confirmed from the example of Zeeman effec[11].

In Zeeman effect, it is observed that when a strong magnetic field is applied across the source of light giving rise to spectral lines, the single spectral line is split into three lines (i.e. normal Zeeman effect) which means, as the consequence of application of a strong magnetic field, there start emitting three photons of three different frequencies instead of emission of one photon of a single frequency. And when a weak magnetic field is applied across the source of light, the single spectral line is split into several lines (i.e. anomalous Zeeman effect), which means, as the consequence of application of a weak magnetic field, there start emitting several photons of several different frequencies instead of emission of one photon of a single frequency. The emission of two additional photons in the case of normal Zeeman effect, and several additional photons in the case of anomalous Zeeman effect confirm that the orbiting electrons of the source of light are excited and photons are emitted from those when some external magnetic field is applied across the source.

The discontinuously increase in thermal conductivity of specimen, when its superconducting state is destroyed by the application of external magnetic field H_c, also confirms the truth of generation of photons as the consequence of application of external magnetic field H_c (see Sec. 5.8).

5.7.2 Why H_c increases as temperature of specimen decreases beyond its T_c

As the temperature of specimen decreases beyond its T_c, since: 1. The very slow emission of photons from the specimen goes on, the number of photons remaining in the specimen goes on decreasing continuously; 2. The binding force between electrons generated due to interaction between their magnetic fields (see Sec. 5.4) goes on increasing (because, as temperature of specimen decreases, thermal energy and hence thermal agitation of its free electrons goes on decreasing that causes increase in binding force between the electrons); the need of number of photons to destroy the alignment of free electrons of the specimen, goes on increasing. So, to fulfill the need of increasing number of photons to destroy the alignment of free electrons of the specimen, H_c of increasing magnitude is needed. Hence the magnitude of H_c goes on increasing as the temperature of the specimen decreases.

5.7.3 Why H_c varies from substance to substance.

We know that at same temperature, thermal conductivity varies from substance to substance. It happens so because at same temperature, the number of photons emitted from the orbiting electrons which conduct the heat, varies from substance to substance. Therefore, if at some temperature, say $T'(<T_c)$, H_c is applied to different substances to restore their normal states; the magnitude of H_c varies from substance to substance.

5.8 Explanation of why and how thermal conductivity of specimen changes continuously between its two phases and it is discontinuously increased when superconducting state of the specimen is destroyed by the application of an external magnetic field H_c.

5.8.1 Why and how thermal conductivity of the specimen is discontinuously increased when superconducting state of the specimen is destroyed by the application of an external magnetic field H_c

Thermal conductivity of superconductors undergoes a continuous change between their two phases and is usually lower in the superconducting phase. But it changes discontinuously when superconducting state of specimen is destroyed by the application of external magnetic field H_c. For example, at 2 K, thermal conductivity of Tin (for which $T_c = 3.73\,K$) has value $34\,W\,cm^{-1}\,K^{-1}$ for the normal phase and $16\,W\,cm^{-1}\,K^{-1}$ for the superconducting phase (see Ref. 12).

In order to destroy the superconducting state of specimen when critical value of external magnetic field H_c is applied across the specimen, large number of orbiting electrons of the specimen are excited (depending on the magnitude of H_c) resulting into sudden emission of large number of photons. The sudden production of large number of photons in the specimen causes discontinuous increase in the thermal conductivity of the specimen because the photons are the radiation energy carrier[7] and the heat energy is conducted through transportation by the photons. Consequently the thermal conductivity of specimen under goes a discontinuous change between its two phases.

5.8.2 Why and how thermal conductivity of specimen changes continuously between its two phases, and how at superconducting phase, it is found to be lower

When superconducting state of specimen is obtained by bringing down its temperature to its T_c, since the photons are not disappeared from the specimen suddenly in bulk but disappear continuously, quite fast in the beginning and very shortly becomes very slow (see Sec. 2.1), thermal conductivity of specimen does not undergo a discontinuous change but undergoes a continuous change between its (specimen) two phases.

Further at T_c, i.e. at superconducting phase, since the number of photons is reduced very much, thermal conductivity becomes lower.

5.9 Explanation of: (i) energy gap between electrons at normal state and electrons at superconducting state of the specimen; (ii) why energy of electrons goes on decreasing as temperature of specimen decreases below T_c

5.9.1 Energy gap between electrons at normal state and electrons at superconducting state of the specimen

At superconducting state of specimen, when the planes of magnetic fields of its free electrons are oriented and aligned in a plane perpendicular to the direction of flow of persistent current, due to interaction between magnetic fields of electrons there is generated a force of attraction between electrons (see Sec. 5.4). This force of attraction keeps electrons bound together, and due to that binding, the energy of free electrons of the specimen at its superconducting state is being reduced, which causes an energy gap between electrons of specimen at its superconducting state and electrons at its normal state.

5.9.2 Why energy of electrons goes on decreasing as temperature of the specimen decreases below T_c

As temperature of specimen decreases below its T_c, (i) due to decrease in thermal energy of its free electrons, thermal agitation of electrons against the binding force generated among those due to interaction between their magnetic fields goes on decreasing, and (ii) the number of photons, left in the specimen, too goes on decreasing [see Sec. 2.1.1(a)]. Therefore, the binding force among electrons goes on increasing continuously and consequently energy of electrons goes on decreasing as temperature of specimen decreases below its T_c.

5.10 Explanation of Josephson's Tunneling

The Josephson's effect is the phenomenon of supercurrent across two superconductors coupled by a weak link. The weak link can consist of a thin insulating barrier known as S-I-S (superconductor-insulator-superconductor), or S-N-S (a short section of no-superconducting metal), or S-s-S (a physical construction that weakens the superconductivity at the point of contact).

Why and how the phenomenon of supercurrent across the weak link takes place, is as follows:

When a voltage is applied across the weak link, the directions of L_s, i.e. the directions of linear velocity of free electrons of both the superconductors of the weak link are oriented and aligned parallel but opposite to the direction of the applied voltage. Now, if the applied voltage is removed, the orientation and alignment of linear velocity of free electrons of both the superconductors of the weak link remain oriented and aligned as such because in both the superconductors, the number of photons are reduced very much and hence those fail to disturb the orientation and alignment of the directions of linear velocity of free electrons..

Since electrons possess spin motion too along with their linear motion, electrons possess M.E. and M.M. (see Sec. 3.2) and hence possess more penetrating power in comparison to particles having only linear motion. Secondly, when the directions of linear velocity of electrons are oriented and aligned, electrons incident almost normally at the surface of the weak link, the power of penetration of electrons through the weak link is increased more. Therefore, when the applied voltage is removed, the flow of electrons and hence of the supercurrent remains continued, i.e. the phenomenon of supercurrent across the weak link is obtained.

5.10.1 A short discussion

The prediction of a mathematical relationship for current and voltage across the weak link by Josephson[13] is based on quantum mechanical treatment of the phenomenon, transmittance T = finite for particle having energy $E < V_0$ (where V_0 is the potential energy of the barrier). But the quantum mechanical treatment of the phenomenon, transmittance T

= finite for particle having energy $E < V_0$ is not true because it is based on the concept of wave nature of particle while the concept of wave nature of particles is not true (for its confirmation, see Ref. 7). This phenomenon takes place due to spin motion of particles. How this phenomenon takes place due to spin motion of particles, see Sec. 4.1.2, Ref. 5.)

5.11 Explanation of latent heat of transition

When superconductivity of a specimen is destroyed isothermally (i.e. at constant temperature) by a magnetic field, the specimen absorbs heat and that happens to be the latent heat. For the adiabatic case (constant heat), the specimen's temperature becomes lower. In the isothermal case, when the field is reduced and the specimen restores its superconducting state, the superconductor gives up that latent heat of transition.

Why and how the specimen absorbs heat when superconductivity of the specimen is destroyed isothermally by a magnetic field is as follows:

When the magnetic field is applied to destroy the superconducting state of the specimen, the orbiting electrons of specimen are excited and photons are emitted from them (see Sec.5.7). Then obviously those electrons need some energy for their excitation which is drawn from the heat energy of the specimen (for its confirmation, see Ref. 14). Consequently, the heat energy of specimen is being reduced. If the temperature of specimen is maintained constant, the heat energy drawn by the orbiting electros from the specimen is absorbed by the specimen from the atmosphere in the form of latent heat. If the field is reduced isothermally and the specimen restores its superconducting state, the heat energy absorbed earlier by the specimen from the atmosphere in the form of latent heat is now given up by the specimen.

If the temperature of the specimen is not maintained constant, i.e. adiabatic case, then due to absorption of heat energy by the orbiting electrons for their excitation from the heat energy of the specimen, the temperature of the specimen is lowered down.

5.12 Explanation of why and how the specific heat of specimen is discontinuously increased when temperature of specimen is brought down to its T_c

The orbiting electrons of the specimen derive some part of heat energy for their excitation from the heat energy subjected to increase the internal thermal energy of the specimen (for its confirmation, see Ref. 14), and hence the heat energy left in the specimen, say dE_{int}, in order to increase its internal thermal energy is being reduced. Consequently specific heat $C_v = dE_{\mathrm{int}} / dT$ of specimen is found to be reduced (for detail, see Ref. 14).

As temperature of specimen decreases to arrive at its T_c, since the heat energy of specimen goes on decreasing (but probably not so fast as temperature of specimen decreases), more and more orbiting electrons go on becoming unable to excite and emit photons because of non availability of sufficient amount of energy for their excitation. And thus at temperature T'_c (or T' because T'_c and T' are same, see Sec. 5.2), all the orbiting electrons become unable to excite and emit photons. So at temperature T'_c, lot of internal thermal energy, which would have earlier been absorbed by the orbiting electrons for their excitation if those had found it to be sufficient for their excitation, is left stored in the specimen. If at this stage specific heat of specimen is measured, an abrupt increase in it shall be found. Consequently, specific heat of specimen is discontinuously increased when temperature of specimen is brought down to its T_c.

Currently, there is no concept of temperature T'_c and it is assumed that the resistance of specimen is suddenly decreased to zero at T_c. Further, a very little difference of temperature is found too between T'_c and T_c, e.g. of 0.05° K for mercury [see Sec. 2.1.1 (a)]. And hence it can be assumed that in place of increasing specific heat of specimen discontinuously at T'_c, it increases discontinuously at T_c.

6. DISCUSSION

For BCS theory, it is claimed that it provides better quantum explanation of superconductivity and accounts very well for all the properties exhibited by the superconductors. But if we go through this theory and its rigorous mathematical proofs closely and intently, we find that it is based on such concepts which: 1. Are practically not possible (see below bullet i); 2. Contradict two well-observed facts (see below bullet ii); 3. Give rise to numerous very basic and fundamental questions of which no explanation can be given (see below bullet iii).

i. The concepts, which are practically not possible

In BCS theory, it is assumed that at T_c of specimen, when an electron approaches a positive ion core, the core suffers attractive Coulomb interaction and that sets the core in motion and consequently the lattice is distorted. But, can it ever be possible that an ion core, which is obtained as the consequence of ejection of electron(s) from a neutral atom and hence happens to be approximately $1.84A\times10^3$ (where A is mass number, $1.84\times10^3 =$ m_n / m_e, and m_n and m_e respectively are the mass of nucleon and mass of electron) times heavier than the electron, is attracted by the electron, and that attraction sets the ion core in motion, and the motion of core distorts the lattice which is a regular periodic array of number of atoms? No. Practically it cannot be impossible. The most surprising things are:

1. The electron, which was earlier a part of such an ion core before its (electron) ejection from that ion core because of thermal agitation at $T >> T_c$ (because, according to existing concept, the ion cores and free electrons are generated as the consequence of ejection of orbiting electrons from their orbits due to their thermal agitation), exerts such a strong force on that ion core instead of being absorbed back into that ion core! Can it be believed or possible?

2. The electron, when approaches a positive ion core, attracts the ion core so strongly that the ion core is set in motion and that distorts the lattice, while on the other hand, the same electron, when forms a Cooper pair with another electron as the consequence of electron-lattice-electron interaction, the Coulomb repulsive force between the electrons (of Cooper pair) becomes negligible and the pair persists as long as the persistent current flows. Can it practically ever be possible? Probably, in order to avoid such questions, in BCS theory a postulate has been taken that the Cooper pairs start forming and the superconductivity occurs when the attractive interaction between two electrons by means of a phonon exchange dominates the usual repulsive interaction between electrons. But this postulate does not convince. Secondly, it gives rise to several questions (see below bullet iii) of which no answer can be given.

ii. The concepts, which contradict two well-observed facts

If due to Coulomb attractive interaction between electron and the ion core of specimen, its ion core is set in motion and consequently the lattices is distorted, then the energy and disorderness in the specimen should be increased and consequently entropy of specimen should be increased, while on the contrary the entropy of specimen is decreased. Further, due to setting of ion cores into motion etc., the resistance of the specimen should also be increased, while on the contrary it is reduced to zero.

iii. The concepts, which give rise to numerous such questions of which no explanation can be given:

1. At T_c of the specimen, why, how and what situation is suddenly being created in it that its electrons when approach positive ion cores, the cores start suffering attractive Coulomb interaction? Why and how is this situation not being created at $T > T_c$? The postulate, mentioned above, has been taken in order to avoid such questions too. But such questions cannot be avoided because the situation of applicability of the above postulate

arises later on when the core is set in motion and that distorts the lattice, not before that. Further, the above postulate too gives rise to several questions, e.g., why, how and what situation is suddenly being created at T_c that the attractive interaction between two electrons by means of a phonon exchange starts dominating the usual repulsive interaction between the electrons? Why and how is that situation not being created at $T > T_c$.

2. Why and how only in few substances (because superconductivity takes place only in few substances, not in all) are their ion cores set in motion due to the suffering of attractive Coulomb force when their electrons approach their ion cores? Why and how does it not take place in all the substances?

All the above drawbacks of the concepts of BCS theory lead to conclude that the concepts of BCS theory are not true. And hence the BCS theory too should not be true.

Further, since the concepts that when an electron approaches a positive ion core, the ion core is set in motion and the motion of core distorts the lattice etc., cannot be true, there does not arise any question of emission of virtual phonons from the lattices. Therefore, the occurrence of electron-lattice-electron interaction and hence the formation of Cooper pairs cannot be possible. Furthermore, the concept of Cooper pairs gives rise to several very basic and fundamental questions also of which no answer or explanation can be given. For example:

1. According to existing concept of Cooper pairing, the Cooper pairing starts at T_c and their number goes on increasing till T = 0 K. Therefore, if the persistent current flows due to flow of Cooper pairs, the strength/intensity of persistent current should go on increasing as the temperature of specimen decreases. Does the strength/intensity of persistent current increase as the temperature of specimen decreases?

2. Applying H_c when the normal state of specimen is restored (i.e. when the persistent current stops flowing), are the Cooper pairs broken and the electrons are separated from

their respective pairs? If the Cooper pairs are broken and the electrons are separated from their respective pairs, how does it happen? And if the Cooper pairs are not broken, the question arises, then how does the persistent current stop flowing?

3. In the specimen at its normal state, when a current starts flowing through it, diamagnetism is generated in it due to orientation and alignment of μ_s , L_s etc. of its free electrons and interaction between their (free electrons) magnetic fields (see Sec. 4, Ref. 1). In the specimen at its superconducting state, if the persistent current flows as the consequence of flow of Cooper pairs, how is the diamagnetism generated in it?

4. At temperatures $\leq T_c$ of specimen, if the persistent current is obtained due to the flow of Cooper pairs, how and from where do the Cooper pairs obtain their initial linear velocity with which they start flowing and how that is maintained for indefinitely long time against the gravitational force acting on them during their persistent flow?

5. At temperatures $\leq T_c$ of specimen, if the persistent current is obtained due to the flow of Cooper pairs, the directions of motion of Cooper pairs must be oriented and aligned in one direction, i.e. along the direction of flow of persistent current (otherwise the persistent flow of Cooper pairs for indefinite long time cannot be obtained). How are the directions of motion of the Cooper pairs oriented and aligned in one direction?

7. AN IMPORTANT CONCLUSION

Superconductivity is an electromagnetic phenomenon. It cannot be a quantum mechanical phenomenon.

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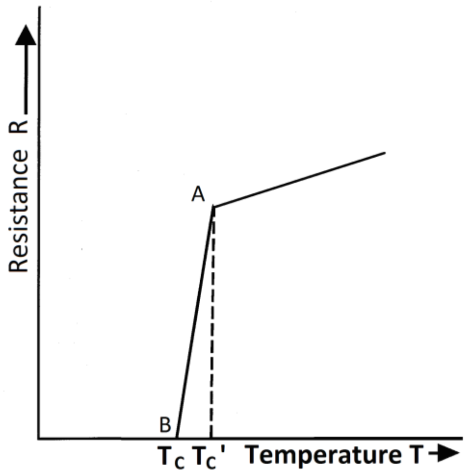
FIGURE CAPTIONS

Fig. 1: Variation of resistance with temperature near the transition temperature.

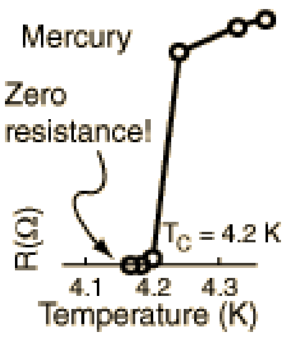
Fig. 2: (a) Spherical ball, dark solid line circle and concentric broken line circles respectively represent the charge, magnetism and magnetic field of electron. (b) Cross sectional view of electron where, in order to introduce arrow marks with the ball of charge to show the direction of its spin motion, the ball of charge has been shown by a dark thick solid line circle.

Fig. 3:**:** 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 positions of lattices in the specimen.

Fig. 4: Longitudinal view of magnetic field generated around and along the length of specimen 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 persistent current i through the loop.

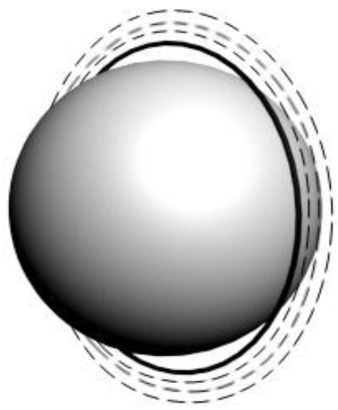

Resistance R
A
B
T_C T_C'
Temperature T

(a)

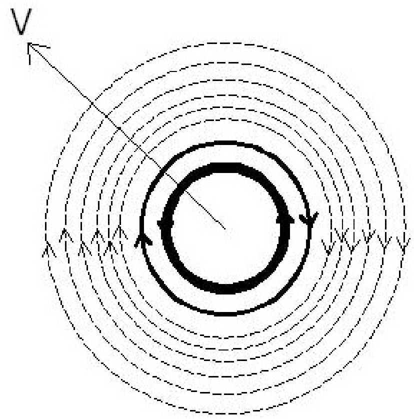

Mercury
Zero resistance!
R(Ω)
T_C = 4.2 K
4.1
4.2
4.3
Temperature (K)

(b)

Fig. 1



(a)



(b)

Fig. 2

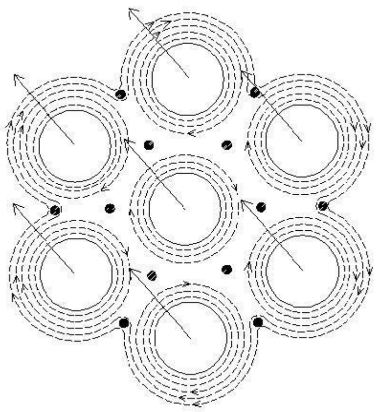


Fig. 3

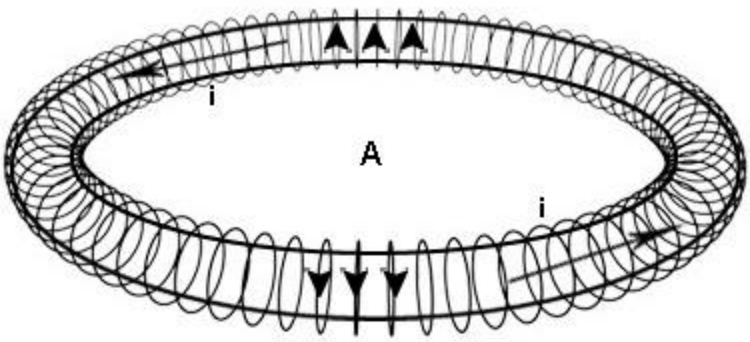


Fig. 4