Study on Internal Mechanisms of Charge, Current, Electric Field and Magnetic Field

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Abstract: In the history of physics, great achievements have been made in the field of electromagnetism making us aware of the existence of charge, current, electric and magnetic fields. However, what is the essence of charge, current, electric and magnetic fields? This remains a mystery. If we can unravel these puzzles, it can not only meet our curiosity, but also contribute to the development of electromagnetism. Fortunately, we have made it and got some interesting findings: an electric charge is the impulse of electronic angular momentum; the quantity of charges is the quantity of electronic angular momentum impulses; a conduction current is a conduction force flow (current is a type of force flow); an electric field is a magnetic field in nature (because triboelectrification produces a magnetic field); a magnetic field is the superposition state of multiple medium impulse moments; the electromagnetic force is medium impulse moments produced by the collision of electronic angular momentum pulses with medium photons .

Key words: charge; current; electric field; magnetic field;

Introduction:

So far, the theoretical system of contemporary physics is a phenomenological one. However, with the development of science, we are no longer simply satisfied with the interpretation of natural phenomena, but are inclined to explore the essence behind these natural phenomena.

This is the trend of scientific development. Especially for the classical electromagnetism theory system, which is a very typical phenomenological theory of physics system, has achieved great success and can explain a variety of electromagnetic phenomena. Nevertheless, we are only familiar with the principles, without knowing the exact reason why it runs, which has led to many unsolved mysteries. So, we have infinite curiosity, such as what is the nature of an electric current? What is the nature of an electric charge? Why do same/opposite electric charges repel/attract each other? What is the nature of a magnetic field? Why do similar/different poles of magnet repel/attract each other? Are these two forces the same kind of force? These are all the mysteries we want to unravel.

In the history of science, many scientists have tried to use one of the forces to explain another force. Unfortunately, none of them ever succeeded. An electric field and a magnetic field have both correlations and differences. In terms of correlations, it is believed that static electric charges produce electric fields, while moving electric charges produce magnetic fields. An electric field and a magnetic field can be transformed into each other. As to their differences, an electric field is an active gradient field, while a magnetic field is a passive spin field. Therefore, we have always believed that electric and magnetic fields belong to two different objects, but they can actually be transformed into each other. However, in a recent study, we have made new breakthroughs. We have found that conduction current is a conduction force flow, a charge is the impulse of electronic angular momentum, and the quantity of charges is the quantity of electronic angular momentum impulses. The positive and negative charge forces are the magnetic forces of the two poles. A magnetic field is a feasible way to explain an electric field. A magnetic force is the medium impulse moment generated by the collision of electronic angular momentum pulses with medium photons. A magnetic field is a combination of multiple impulse moments of a force system. Thus, we have successfully explained the intrinsic mechanism of current, positive and negative charges, electric field and magnetic field, and explained the electric field from the aspect of the magnetic field. Based on our breakthroughs, we modified the Maxwell equations and predicted that the triboelectrification phenomenon is a result of friction generating a magnetic field.

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1: Study on the Internal Mechanism of Charge and Current

According to the classical electromagnetic theory [1], the conduction current is the quantity of charges that flow across a section of a conductor per unit time, which can be expressed mathematically as follows:

$$I = \frac{dq}{dt} \qquad (1)$$

Since the conduction current is only a hypothesis, we need a more visual explanation, considering that we are unaware of what the nature of the charges is. Therefore, the interpretation of the current with the direction of the electrical charges appears too abstract, and we need a more vivid explanation. Here, we can regard the current as a force flow. That is to say, the current is the force transfer of momentum P between electrons. Because electrons are in circular motion, so here the electronic momentum P is the electronic angular momentum impulse u, namely $P \Rightarrow u$. The current I can be expressed as the quantity of electronic angular momentum impulses u that flow across a section of a conductor per unit time. Thus the nature of an electric charge is the electronic angular momentum u, while the nature of charge quantity q is the quantity n of electronic angular momentum impulse u. That is to say, $q \Rightarrow n$. Then the conduction current can become a conduction force flow:

$$I_n = \frac{dn}{dt} \qquad (2)$$

According to Eq. (1) and Eq. (2), the electric current can be explained by the transfer of electric charges and the transfer of electric momentum. By contrast, the transmitted force flow can explain the electric current more vividly. The explanation by the latter is more accurate than by the former.

Then, the new current density can be expressed as:

$$J = \frac{dn}{dt \bullet ds_\perp} \qquad (3)$$

If the number of carriers per unit volume in the conductor is N, then $\rho = Nn$ (n is the electric momentum of a single carrier). Then the current density in the conductor is:

$$J = Nnv \qquad (4)$$

The relationship between the current density and the current on surface s is:

$$I = \iint_s j \cdot ds \qquad (5)$$

On closed surfaces, it is:

$$I = \oiint_s j \bullet ds \qquad (6)$$

The continuity equation of the current is:

$$I = \oiint_s j \bullet ds = -\frac{dn_{\text{int}}}{dt} \qquad (7)$$

Suppose the internal electric momentum of the power supply is the non-electrostatic force of the electron $\overline{F_k}$, then the non-electrostatic forces of the unit electrons in the power supply are $\overline{E_k} = \overline{F_k} / n_k$.

Non-electrostatic forces remove the unit electrons from the b end (negative) of low potential energy to the a end (positive) of high-potential energy through the power supply. The work done is:

$$\varepsilon = \int_{b \to a} E_k \bullet dl = \int_b^a E_k \bullet dl \qquad (8)$$

Then, the voltage can be expressed as:

$$U_{ab} = V_a - V_b = \int_a^b E \cdot dl \qquad (9)$$

From the above, we can see that the current is produced during the process where electrons move from high potential energy to low potential energy to seek a force balance.

The resistance is expressed as:

$$R = \frac{\rho l}{s} \qquad (10)$$

which stands for the resistance against force transmission produced by the electrons in an object when they move from one end of the high potential energy to the other end of the low potential energy.

The relationship between voltage, current and resistance meets the Ohm's Law:

$$U = IR \qquad (11)$$

As regards the problem that the metal wire generates heat after power work, it also meets the

Joule - Lenz law

$$dQ = I^2 Rdt \qquad (12)$$

In summary, we can see that the conduction force flow can explain all the electrical mechanisms of the conduction current. At the same time, the conduction force mechanism is simpler and more lucid than the conduction current mechanism. Therefore, we believe that the conduction force mechanism is more accurate and complete than the conduction current mechanism system. We have successfully proved that the nature of charges in the conduction current is the electronic angular momentum impulse and the essence of the current is a force flow.

2: Study on the Intrinsic Mechanisms of Electric and Magnetic Fields and a Feasible Way to Interpret Electric Fields from the Aspect of Magnetic Fields

According to the classical electromagnetic theory, the electric field intensity is expressed as:

$$E = \frac{F}{q} \qquad (13)$$

As is shown above, the nature of the charge is the impulse u of the electronic angular momentum. According to the traditional theory, the electric field is generated by the charge, and the photon is the medium particle of the electric field. It follows that the electric field force is the force produced by the collision of electronic angular momentum impulses with photons. This force is an impulse moment, expressed as $M = r \times u$. The impulse of the electronic angular momentum is generated by electron spin and orbital motion, so the field source of the electric field is the electron e, namely $q \Rightarrow e$. Given that the magnetic field is generated by the molecular magnetic moment $\sum m \neq 0$, while the magnetic moment is generated by the electron spin angular momentum and orbital angular momentum, and also given that t the photon is the medium particles of the magnetic field, then the magnetic field force can also be seen as the force produced by the collision of electronic angular momentum impulses with photons. This force is also an impulse moment, expressed as $M = r \times u$. Accordingly, the field source of the electric field is the electron e. Therefore, we can deduce that the electric field E and the magnetic field H have the same field source, which is the electron e. So we can get a powerful equation that explains that a magnetic field and an electric field have the same field source:

$$H = E = \frac{F}{e} \qquad (14)$$

According to the above derivation, since the electric field and the magnetic field have the same field source, the electric field and the magnetic field belong to the same object. This signifies that the nature of the electric field is the magnetic field, so the nature of the electric field force is the magnetic force and the acting force of the positive and negative charges is the acting force of the two magnetic poles. Therefore, we explain the electric field from the aspect of the magnetic field, and explain the acting force of positive and negative charges from the aspect of the magnetic force.

Since we have explained the electric field from the aspect of the magnetic field, we need to explain the nature of magnetic and magnetic forces. For the nature of the magnetic force, we can assume from the kinetic point of view that the impulse of the angular momentum impinging on the photon of the medium causes the photon vortex to move, which in turn produces a medium impulse moment (similar to fan blowing). The medium impulse moment is the magnetic force, and the essence of the magnetic force line can be regarded as the cyclotron motion path of the medium photon. Thus, the magnetic force represents the cross product of the impulse u applied by the electron to the photon of the medium with the vector of the photon displacement vector r, which can be expressed mathematically as:

$$M = r \times u \qquad (15)$$

Magnetic field can be defined as "a vortex force system generated by photon cyclotron motion of electrons colliding with multiple spins", that is,the superposition state of the magnetic moment. Its mathematical expression is:

$$M = \sum m \qquad (16)$$

If the magnetic field line is used to express the magnetic field, then the magnetic field can also be expressed with the geometric changes of field strength and magnetic flux:

$$\Phi_H = \iint_s H \bullet ds \qquad (17)$$

In this way, we defined the nature of magnetic field and magnetic force, and thus unraveled the mystery about the intrinsic nature of electromagnetic field and electromagnetic force, which is what the traditional theory cannot do and another highlight of this article.

According to the law of Ampere Circle $\oint_L B \cdot dl = \mu_0 \sum_{i=1}^{n} I_i$, the relationship between the magnetic field strength and the current in the current-carrying conductor can be expressed as:

$$\oint_L H \cdot dl = \mu_0 \sum_{i=1}^{n} I_i \qquad (18)$$

Taking into account that the field source of the magnetic field is the electron e, the force applied on static electrons in the magnetic field is:

$$F = eH \qquad (19)$$

The force applied on moving electrons in the magnetic field is :

$$F = ev \times H \qquad (20)$$

The total force acting on the current-carrying conductor in the magnetic field is:

$$F = \int_L dF = \int_L de \times H \qquad (21)$$

Taking into account that the field source of the magnetic field is the electron e, and the impulse momentum produced by per unit electron is M_e. With reference to Biot-Savart law, it indicates that the physical meaning of current element is the electronic impulse moment $Idl \Rightarrow M_e$. Then the magnetic field strength generated by the electron at any point in the space can be expressed as:

$$dH = \frac{dM_e \times e_r}{r^2} = \frac{Idl \times e_r}{r^2} \qquad (22)$$

The vector integral form is:

$$H = \int_L dH = \int_L \frac{dM_e \times e_r}{r^2} \qquad (23)$$

The magnetic interaction between two electrons can be expressed as:

$$dF_{1\to 2} = \frac{dM_{e2} \times (dM_{e1} \times e_r)}{r^2} \qquad (24)$$

When the vector is not considered, the acting forces between two electrons can be idealized as $F_{1\to 2} = \frac{e_2 e_1}{r^2}$. The equivalent Coulomb's law thus can be derived:

$$F_{1\to 2} = \frac{e_2 e_1}{r^2} \Leftrightarrow \frac{q_2 q_1}{r^2} \qquad (25)$$

It can be seen from the above that we can deduce the equivalent Coulomb's law from the angle of the magnetic field, and prove that the Coulomb electrostatic field is a current element magnetic field. Thus we can make a prediction: "The triboelectrification phenomenon occurs because friction generates a magnetic field." The mechanism is: friction produces a conduction force flow (current), and conduction force flow (current) polarizes friction body and light objects within the magnetic moment. As a result, the friction body and light objects are outwardly magnetic, and the two magnetic objects will attract each other, and then rubbed objects have the ability to attract light objects. The nature of this is the interaction between the two magnetic fields. That is why we claim that the triboelectrification phenomenon appears because friction generates a magnetic field.

EXPERIMENTAL VERIFICATIONS: We can verify this conclusion by observing whether a strong magnetic field is capable of attracting light objects (paper scraps).

Discussion: If we see the phenomenon that a strong magnetic field can attract light and small paper scraps, the theory is correct and we will need to revise the textbook. If we do not see such a phenomenon, the theory is wrong. (Although we have carried out experiments to verify our conjecture, we still invite you to verify our theory through repeated experiments).

Experimental equipment: power supply（AC）, voltage regulator, after the power to generate magnetic field copper coil, paper, field strength measuring instrument

Experimental steps:
1: Series the power supply（AC）, voltage regulator and copper coil
2: Sprinkle paper scraps around the copper coil
3: Turn on the power supply, through the voltage regulator to control the current, observe the copper coil around the magnetic field can attract paper scraps.
4: In the experiment, we can see that the greater the current, the greater the intensity of the magnetic field, attracting the more intense.

This experiment proves that the strong magnetic field can produce the friction electrification phenomenon.

Note: Because the permanent magnet field strength is relatively small, it can not be magnetized and attract scraps of paper.

The force exerted by the current carry conductor L_1 on the electron e_2 is:

$$dF_{1\to 2} = M_{e2} \times \int_{L_1} \frac{dM_{e1} \times e_r}{r^2} \qquad (26)$$

The force exerted by the current carrying conductor L_1 on the current carrying conductor L_2 is:

$$F_{1\to 2} = \int_{L_2} dF_{1\to 2} = \int_{L_2}\int_{L_1} \frac{dM_{e2} \times (dM_{e1} \times e_r)}{r^2} \qquad (27)$$

On the contrary:

$$F_{L_2 \to L_1} = -F_{L_1 \to L_2} \qquad (28)$$

From the above, we can extrapolate that the magnetic field excited by the impulse of the electronic angular momentum follows the inverse square of the distance.

The moment of forces in the magnetic field can be expressed as:

$$M = m \times H \qquad (29)$$

According to Faraday's law of electromagnetic induction, we can work out the relationship equation between EMF and magnetic field strength:

$$\varepsilon_i = -\frac{d\Phi}{dt} = -\iint_s \frac{\partial H}{\partial t} \cdot ds \qquad (30)$$

It can be inferred from the above deduction that we can theoretically explain all the electric field phenomena from the aspect of the magnetic field, and predict that triboelectrification is a result of friction generating a magnetic field, which is another major breakthrough point in this paper.

DISCUSSION: If triboelectrification is essentially a phenomenon where friction produces a magnetic field, then the unipolar electrostatic field is actually a dipole magnetic field. We can verify this by seeing if the charged scraps in the triboelectrification phenomenon have the magnetic properties of the two poles. If so, we need to revise the textbook, and if not, it means that the theory here is wrong.

Experimental verification: We can place a magnetic screwdriver close to the two ends of charged scraps of paper respectively to see whether there are attraction and repellence taking place. If the screwdriver attracts either end of paper and repels the other end of the scraps of paper, then the static Field is a dipole field; conversely, it will indicate that the electrostatic field is not a dipole field, and that the theory under discussion is wrong. (Although we have conducted experiments repeatedly for verification, you can still feel free to verify our theory through repeated experiments)

3: Re-modification of Maxwell's Equations

According to the above deduction, the nature of the electric field is a magnetic field, so the same objects cannot be transformed into each other, and we need to modify the Maxwell equations.

According to the above-mentioned derivation of Faraday's law of electromagnetic induction, the electromotive force in the magnetic field is:

$$\varepsilon_i = -\frac{d\Phi}{dt} = -\iint_s \frac{\partial H}{\partial t} \cdot ds \qquad (31)$$

Since the electromotive force ε_i represents the kinetic energy of the electron, we do not need to

introduce an abstract electric field.
The fourth equation of Maxwell's equations is:

$$\oint_L H \cdot dl = I_{oint} + \iint_s \frac{\partial D}{\partial t} \cdot ds \qquad (32)$$

Considering that the current density of electric displacement is $J_d = \frac{\partial D}{\partial t}$, and the current density of the conduction force flow is $J = \frac{dn}{dt \cdot ds_\perp}$, then the relationship between the electric displacement D and the quantity of electronic angular momentum impulses n can be expressed as $\partial D = \frac{\partial n}{\partial s}$, so the above equation can be improved as follows:

$$\oint_L H \cdot dl = I_{oint} + \iint_s \frac{\partial n}{\partial t} \qquad (33)$$

Which signifies the varied quantify of electronic angular momentum impulses can generate a magnetic field.

Considering that the electric field and the magnetic field have the same field source, namely the electron e, the equations of the Maxwell's equations of the electric field and the magnetic field can be overlooked. The new modified Maxwell's electromagnetic transformation equation is as follows,

$$\begin{cases} \varepsilon_i = -\iint_s \frac{\partial H}{\partial t} \cdot ds \\ \oint_L H \cdot dl = I_{oint} + \iint_s \frac{\partial n}{\partial t} \end{cases} \qquad (34)$$

According the above derivation, a varied magnetic field can produce an electromotive force and the varied quantity of electron momentum can produce a magnetic field which means, even without electric charges and a electric field, we can still explain how a varied magnetic field generates current and vice versa. We have further developed and perfected electrodynamics by simplifying electromagnetics to magnetism.

4: Summary

If we look back upon the development history of electromagnetics, in 1746, the American physicist named Franklin first propounded the idea of positive charges and negative charges; in 1791, the Italian scientist Jia Fani put forward the concept of electric current, and then the French physicist Ampere developed the current theory; the British physicist Faraday advanced the idea of the electric field and the magnetic field; then in 1865, the British physicist Maxwell unified the electromagnetism. Heretofore, the traditional electromagnetism theory system was a success. However, we are well aware that although Maxwell unified the electromagnetism, he only proved that electricity and magnetism can be converted into each other, and we cannot use either of the two physical quantities to explain the other. Besides, no one has ever really explained the internal mechanism of current, positive and negative charges, as well as the electric field and the magnetic field, which has left many unsolved mysteries to the contemporary theoretical system of physics as a result, and this is the limit to the traditional electromagnetism theory system. However, the development of science requires us to solve these problems. Fortunately, we have successfully unraveled the aforesaid puzzles and simplified electromagnetism to magnetic, make a major breakthrough in the field of electromagnetics. As the new theoretical system of this paper has just been put forward, many aspects are not mature yet, so we still need to do further research. I hope more people will participate in our research in the future. Your tolerance and pointing-out of the errors in this paper will be highly appreciated.
At the same time, because the object of this paper is a most basic physics issue and innovations come from first-hand knowledge and experience, there is no reference work for us to draw on, so we have decided to cite a textbook in order to show our respect for the work of the predecessors.

【1】Shizhong Huang and Zhixiang Ni，College Physics/Vol 2. (Beijing Higher Education Press, Beijing, 2.2014). Art