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Essence of the Magnetism

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Abstract In this paper, it is proposed that the magnetic field is an electric field that contracts in the direction of motion. This viewpoint is taken as the basic principle of analyzing the magnetic phenomena. The law of Lorentz force is proved by deduction, and any necessary correction is made. The law of electromagnetic induction is also proved by deduction, and the specific physical process of electromagnetic induction is clarified. The displacement current and Ampere circuit law is also proved by deduction. It is considered that the contraction of electric field in the direction of motion is the source of generation of magnetism, while the contraction of electric field in the direction of motion is fundamentally derived from the principle of constancy of light velocity. Since the magnetism has contributed the modern science and technology to the human beings, so it is convinced that the principle of constancy of light velocity is the most precious gift which the God has given to mankind. The motion with variable velocity of the electric field is also analyzed. It is pointed out that the generation of electric wave is essentially resulted from the distortion and contraction of the electric field caused by the propagation of the motion with variable velocity of the electron of the wave source at the velocity of light in its electric field. The electric field energy of the electric wave is propagated by the distortion of the electric field, while the magnetic field energy of the electric wave is propagated by the contraction of the electric field. The electric field energy is identically equal to the magnetic field energy. The electric field signal and the magnetic field signal are always in the same phase. The law of electromagnetic induction is derived from a distorted electric field. The common electromagnetic induction phenomenon is essentially a transmission and reception effect of electric waves. It is proved that the Ampere circuit law is derived from the displacement current, and that the displacement current is derived from the magnetic field, which is the electric field in motion. The propagation of electric wave is analyzed. It is pointed out that, if the propagation velocity of electric wave is greater than the velocity of light, the propagation effect of electric wave will be rapidly weakened. If the propagation velocity of electric wave is less than the velocity of light, the electromagnetic interference and radiation will be increased rapidly. Therefore, it is firmly believed that the actual velocity of light of about 300,000km/s is the best propagation velocity of electric wave for mankind. It is considered that the actual velocity of light is another precious gift which the God has given to mankind.

Keywords: *magnetic field, electric field, special theory of relativity, lorentz force, electromagnetic induction, displacement current, principle of constancy of light velocity, electric wave*

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1. Introduction

Electromagnetics is a stereotyped theory. For more than a hundred years, its basic principle has not changed at all. However, it can be seen from electromagnetics that, almost all the laws of electromagnetics are a summary of some superficial phenomena, lacking the explanation of internal sources. For example, electromagnetics cannot explain why there is a Lorentz force? Why is there an electromagnetic induction? Why is there a displacement current? History has shown that, there are some basic defects in most of the theories derived from superficial phenomena. For example, the geocentric theory established by the ancients based on a summary of superficial phenomena cannot explain many astronomical phenomena. There are also some defects in the classical electromagnetics established based on a summary of superficial phenomena. For example, it is confirmed according to electromagnetics that, the magnetic field is a substance, and that the magnetic field of a permanent magnet can extend to infinity. Therefore, when the magnet is rotating, the magnetic field far away from the magnet will rotate faster. The velocity of rotation of the magnetic field beyond a certain distance is greater than the velocity of light. The velocity of rotation of the magnetic field at infinity can even be infinite. This inevitable deduction clearly violates the principle of constancy of light velocity. For example, the interaction force between a rectangular current-carrying coil and an electric charge in motion outside the coil is analyzed. It is inevitably deduced that, the acting force and counter-acting force of the two are in the same direction but of the different magnitude. This obviously violates the law of counter-acting force. Another example is the explanation of the reduction of the

deflection distance of the charged particles in high-velocity motion in the magnetic field. It is assumed according to electromagnetics that, the charged particles can only have one-sided mass transformation or one-sided time transformation, which violates the basic principle of special theory of relativity that mass, time and length should be transformed simultaneously. It can be seen that all these laws of electromagnetics are based on the magnetic field. Therefore, it can be inferred that there is no scientific understanding of the nature of the magnetic field, which is the root cause of the defects in electromagnetics. Therefore, in order to make electromagnetics become a more scientific and more realistic theory, it is necessary to have a scientific understanding of the nature of the magnetic field.

2. The Magnetic Field is an Electric Field Contracting in Motion

2.1. It is Unscientific to Regard the Magnetic Field as a Real Substance

It is pointed out in connection with the electromagnetic principle that, the current will generate a magnetic field in the surrounding space, that is to say, the current will generate a magnetic field anywhere across any distance. Under what action will the current generate a magnetic field in the surrounding space? Or what is the underlying cause for suddenly generating the magnetic field at a certain point in space? Electromagnetics does not answer this substantive question.

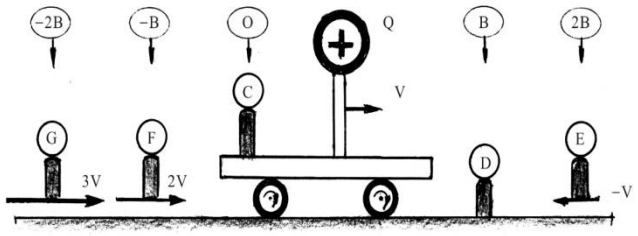

Figure 1. The different magnetic fields have been seen by the different observers.

Figure 1: There are the observer C and the charged body Q on the trolley moving at velocity$V$. There is the observer D on the ground. There is the observer E moving at velocity$-V$. There are the observers F and G moving at velocity $2V$ and $3V$, respectively.

The plane N passing through$V$ vertically Q is taken as the measuring plane. C sees that Q is stationary. He considers that there is no electric current passing through the N plane, and he is sure that there is no magnetic field around$Q$. D sees that $Q$is moving at velocity$V$; the current passing through the N plane is QV; the current will generate a magnetic field; therefore, the magnetic induction intensity B will be generated at the fixed point P on the N plane. However, in the view of the observer E moving at velocity$-V$, the current passing through the N plane is $2QV$, and the magnetic induction intensity 2B will be generated at Point P. In the view of the observers F and G moving at velocity $2V$ and $3V$, the current passing through the N plane is -QV and -$2QV$, respectively, and the magnetic induction intensity -B and -2B will be generated at Point p, respectively.

As mentioned above, for the same electrified body$Q$, it will be considered by the different observers C, D, E, F and G that, there is no any magnetic field at Point P on the N surface; but there are magnetic induction intensities B, 2B, -B and -2B.

As everyone knows, in the view of any observer in different motion, all the real substances, such as a flower and a leaf, are equally real. It is impossible that someone can see the existence of flowers, but the other cannot see the existence of flowers. And it's more impossible for anyone to see one flower turn into two flowers, or the flower blooming upwards turn into the flower blooming downwards. The observers C, D, E, F and G (as shown in Figure 1) consider that, there may be no any magnetic field, or there may be the magnetic induction intensities B, 2B, -B and -2B at the same point P in space. Obviously, if the magnetic field is a real substance, then for the real substance, there can be no completely different understandings, such as real non-existent, real existence, real double existence, real reverse existence, etc. The only possibility is that there is no such substance. Or, the magnetic field cannot be a real substance. It is unscientific to regard the magnetic field as a real substance.

2.2. The Magnetic Field is an Electric Field Being in Motion

The conditions as shown in Figure 1 are further analyzed to explore how to redefine the magnetic field in order to maintain the concept of magnetic field without violating our common sense?

As shown in Figure 1, the Observers C, D, E, F & G are sure that the trolley is a real substance. The difference in the trolley as can be intuitively seen by them is just the different motion conditions of the trolley. Similarly, for the charged body Q on the trolley, they are sure that there is an electric field in the charged body$Q$, and that the electric field is a real substance. The difference as can be intuitively seen by them is just the difference in the motion of the electric field. Therefore, if the magnetic field is defined as an electric field being in motion, then the non-existent or existence of the magnetic field and the difference in the magnitude of the electric field will become the difference between the velocities and directions of motion of the electric field. Obviously, defining the magnetic field in this way avoids the contradiction that the different observers have a fundamentally different understanding of the magnetic field.

By defining the magnetic field as an electric field being in motion, it is easy to explain why the current-carrying wire will generate a magnetic field around it. This is because the current in the wire is the macroscopic movement of free electron in the wire, and the free electron must exist in the electric field generated by itself, i.e. the free electron motion. There is no doubt that the electric field generated by the free electron is accompanied by motion, so that an electric field in motion is generated in space, that is, a magnetic field is generated.

The magnetic field is an electric field being in motion, which means that the magnetic field is not a new

substance independent of the electric field, but a kind of motion that expresses the electric field of the real substance.

Referring to the description of the linear current magnetic field in electromagnetics, it can be determined that the magnetic induction intensity$B$ at a certain point is inevitably proportional to the electric field intensity E generated by the linear current, and also proportional to the velocity of movement$V$ of$E$. There is also$B$, i.e. it is perpendicular to$V$, which is vertical to$E$. Thus, we can assume that:

$$B = PV \times E \text{ (A)}$$

Where, Prepresents the proportionality coefficient.

2.3. Deduced Biot-Shaval's Law

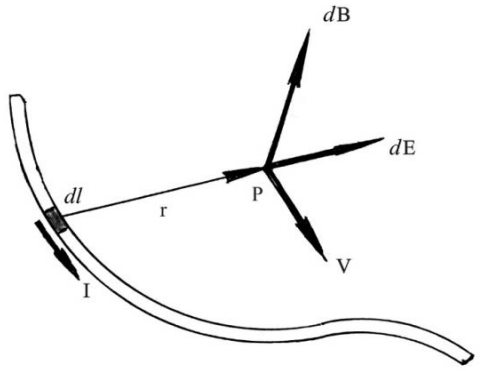

Figure 2. Magnetic field of the current element$I$dl

Figure 2: Calculation of the magnetic induction intensity dB generated by$I$dl at Point P in the current-carrying wire According to electromagnetics, the current is the macroscopic movement of positron (proton) in the wire. If the linear density of the macroscopically-moving positron in the wire is represented byτ, and if the velocity of movement of the positron is represented by$V$, then the electric quantity of the positron in dl should be represented by dQ=τdl, and the current of the positron should be represented by $I = \tau V$. The electric field intensity generated by dQ at Point P

$$dE = \frac{kdQ}{r^2} \cdot r_0 = \frac{k\tau dl}{r^2} \cdot r_0.$$

(r_0- the unit vector in the r direction)

The magnetic induction intensitydB=PV × dE at Point P can be obtained by the formula (A). $V = \frac{I}{\tau}$ can be substituted into this formula.

$$dB = P\frac{I}{\tau} \times \frac{k\tau dl}{r^2} \cdot r_0 = PK\frac{Idl}{r^2} \times r_0.$$

Obviously, this formula is completely similar to the Biot-Shaval's law formula $dB = \mu_0 Idl \times \frac{r_0}{4\pi r^2}$, which can be regarded as the same formula. The proportionality coefficientPK of the two should be the same magnitude as $\frac{\mu_0}{4\pi}$, i.e. $PK = \frac{\mu_0}{4\pi}$. As a result of $K = \frac{1}{4\pi}\varepsilon_0$, there will inevitably be P=$\varepsilon_0\mu_0$. (a) The formula can be written as:

$$B = \varepsilon_0\mu_0 V \times E. \quad (1)$$

Because of $\varepsilon_0\mu_0 = \frac{1}{C^2}$, the formula (1) can also be written as:

$$B = \frac{1}{C^2} V \times E. \quad (2)$$

Although the current in the wire is actually the motion of the negatron, because the velocity of movement of the positron is$V$, the equivalent velocity of the negatron will inevitably be -V; the linear density of the positron will inevitably be τ; and the linear density of the negatron will inevitably be -τ, rather than $-\tau \times -V = \tau V$. The same result will not affect the deduction as mentioned above.

2.4. Misunderstanding of the Lorentz Force and Doubt about the Ampere Force

As shown in Figure 3(a), Q_A is motion at velocity V_A; Q_B is moving at velocity V_B ; the magnetic induction intensity B_A will be generated byQ_B at SectionQ_A; $Q_A$will be subjected to the Lorentz force $F_A = Q_A V_A B_A$. The magnetic induction intensity generated by Q_A at Section Q_B should be 0 according to the Biot-Shaval's law. The Lorentz force $F_B = 0$ will be applied to Q_B. Obviously, this analysis result of $F_A \neq F_B$ cannot meet the law of counter-acting force.

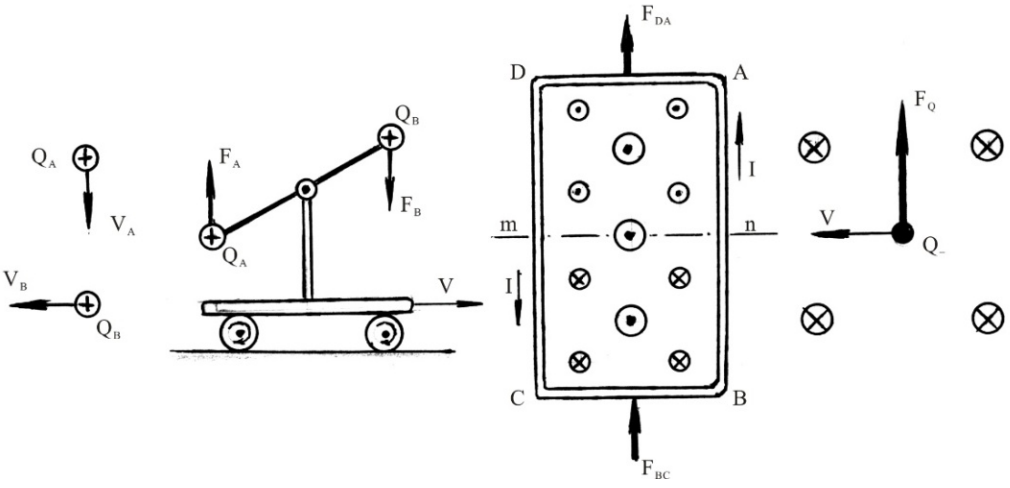

Figure 3. Error analysis of the Lorentz force

As shown in Figure 3(b), the charged body Q_A is connected to the charged bodyQ_B by an insulating rod; the insulating rod can rotate around the Point O; now, Q_A and Q_B are in motion together at velocity$V$; a magnetic field penetrating into the principal plane is generated by the current Q_BV at Section Q_A, so that $Q_A$will be subjected to the force F_A. A magnetic field penetrating through the principal plane is generated by the current Q_AV at Section Q_B, so that Q_B will be subjected to the force F_B. Obviously, F_A is in the opposite direction from F_B, inevitably causing the insulating rod to rotate. Obviously, it is impossible for the insulating rod to rotate, and the analysis of the Lorentz force is wrong.

As shown in Figure 3 (c), the high-voltage discharge anion Q_- is moving along the central line mn of the rectangular current-carrying coil to the coil at velocity V. As shown in Figure 3 (c), a magnetic field penetrating into the principal plane is generated by the coil ABCD at Section$Q$, so that $Q_-$is subjected to an upward forceF_Q; a magnetic field penetrating through the principal plane is generated byQ_- in the upper part of the central line mn of the coil; a magnetic field penetrating into the principal plane is generated in the lower part of the mn. Obviously, the direction of the magnetic field perceived by the current-carrying wires AB and CD of the coi in the upper and lower parts of the central line mn is opposite, while the current direction in the wire does not change. Therefore, the Ampere forces applied to half of the current-carrying wires AB and CD in the upper and lower parts of the central line mn are of the same magnitude and the opposite direction. The comprehensive effect is not to be subjected to force. For the current-carrying wire DA, as the magnetic field generated by Q_- penetrates through the principal plane, the current in the DA will inevitably be subjected to an upward force F_{DA}. Similarly, it is known that the current in the BC segment will also inevitably be subjected to an upward force F_{BC}. Therefore, the total force of the current-carrying coil is equal to the sum of F_{DA} and F_{BC}, and the direction of the upward force is the same as that of F_Q. This result means that the acting force between the current-carrying coil and the moving electric charge is in the same direction as the counter-acting force, which obviously violates the law of acting force. Moreover, it can be deduced that $(F_{DA}+F_{BC}) <F_Q$, and the closer the distance ofQ_- from AB, the greater the difference between the two (deduction omitted), which also means that the acting force between the current-carrying coil and the moving electric charge is not only in the same direction as the counter-acting force, but also is of the different magnitude as the counter-acting force.

Through the above analysis, it is shown that, if the Lorentz force is used to analyze the problem, the analysis result is wrong in some cases. Moreover, as shown in Figure 3(C), through the above analysis of the total Ampere force of the segment AB of current-carrying coil AB being zero, it is also shown that, if the Lorentz force (force of Idl) is used to analyze the problem, any errors may also occur. Moreover, in some cases, the observer even wonders if there is a real Ampere force. For example:

The current-carrying wires A and B of two parallel lines circle around the Earth's equator. It is assumed that the current in the wires AB is the same, and that the equivalent velocities of electron motion as the current in the wires are$V$. The observer who is stationary relative to AB concludes that, a magnetic field is generated by the electron in A moving at velocity$V$, while the electron in B penetrating through the magnetic field at velocity V is subjected to the Ampere force. The observer who is moving at velocity V concludes that, the electrons in AB are all stationary. He concludes that, a magnetic field is generated by the proton in A with the same electric quantity as the electron being in motion at velocity-V, while the proton in B with the same electric quantity penetrating through the magnetic field at velocity-V is subjected to the Ampere force. Moreover, the observer moving at velocity $\frac{V}{2}$ or another velocity concludes that, the magnetic fields are generated by both the electron and the proton in the wire A being in motion, and that both the electron and the proton in the wire B penetrating through the two magnetic fields are subjected to the Ampere force, respectively. It is shown through the above analysis that, for the same two current-carrying wires AB, there are the different results of judgment about which electrons and protons in the wires AB have generated a magnetic field and are subjected to the Ampere force as made by the different observers. So what is the real Ampere force? Obviously, there is no definite answer, which makes the observer wonder if there is a real Ampere force.

2.5. The Root Cause for Generating the Lorentz Force is the Contraction of the Electric Field in the Direction of Motion

As indicated above, in some cases, the results obtained by analyzing the problem based on the Lorentz force or the Ampere force (as a component of Lorentz force) are wrong. This means that there is no Lorentz force in these cases. However, in the case of a uniform magnetic field, the actual analysis results can be obtained according to the Lorentz force. This, in turn, means that there is a real Lorentz force. So why does this mysterious Lorentz force sometimes exist or sometimes not? Obviously, the only possibility is that this mysterious force is not really understood by us. How to understand this mysterious force? Tracing back to the sources, the generation of force in the magnetic phenomenon must be derived from the interaction between all the electrified bodies. Therefore, we should start from the analysis of the two most basic electrified bodies.

Since there is only a constant electrostatic force between the two relatively static electrified bodies, the mysterious force will be inevitably generated during the relative motion of the two electrified bodies. The force of the two electrified bodies will change during relative motion. The only possibility is that the electric field strength acting on the electrified body will change. Due to the motion of the electrified body, the electric field generated thereafter is also accompanied by motion. Therefore, the variation of electric field strength in electric field motion is necessarily possible. It is pointed out according to the special theory of relativity that, the length of a moving object in the direction of motion should be shortened. The electric field is a real substance. Because of the motion of electric field,

the length of the electric field in the direction of motion will inevitably be shortened, causing the electric field strength to change inevitably. Assuming that the distance between the two electric lines of force of a uniform electric field is d_0, and the length of two points of intersection between the two electric lines of force and the horizontal X lines is l_0, when the electric field is moving at velocity$V$ in the X direction, l_0 will inevitably be shortened to $=\frac{l_0}{\sqrt{1-\frac{V^2}{C^2}}}$ according to the special theory of relativity.

Because of $l:l_0=\frac{d}{d_0}$, the distance d_0 between the electric lines of force will inevitably be shortened to $d=d_0\frac{l}{l_0}=\frac{d_0}{\sqrt{1-\frac{V^2}{C^2}}}$. That is to say, no matter how the electric field moves at velocity$V$ in any direction, the distanced_0 between the two electric lines of force of an electric field will inevitably be shortened to $d=\frac{d_0}{\sqrt{1-\frac{V^2}{C^2}}}$.

Since the electric field strength is inversely proportional to the distance between the electric lines of force. Therefore, when the electric field is in motion, the electric field strength E generated when the electric field is static will inevitably be contracted and increased to:

$$E'=\frac{E}{\sqrt{1-\frac{V^2}{C^2}}}. \quad (3)$$

Obviously, when the electric field is in motion, the electric field strength$E$ will inevitably be increased to$E^{'}$, which is the source of mysterious force, i.e. the inevitable source of Lorentz force.

Assuming that the charged electric quantities of the two electrified bodies are Q_A and Q_B, respectively, if the electric field strength generated by Q_A at Section Q_B when the two electrified bodies are relatively static is E_A, and the electric field strength byQ_B at Section Q_A is E_B, then there will inevitably be $F_A=Q_AE_B$, i.e. $F_B=Q_BE_A$ in terms of the magnitude value, and there should be $F_A=F_B$ according to the law of counter-acting force, i.e. $Q_AE_B=Q_BE_A$. When the two electrified bodies are in relative motion, the velocities of relative motion of the two electrified bodies are equal in magnitude and opposite in direction. According to the formula (3), if the magnitude of velocity is the same, the contraction of the electric field must be the same. If E_A is $E_A^{'}=\frac{E_A}{\sqrt{1-\frac{V^2}{C^2}}}$ increased according to the formula (3), E_B will inevitably be increased to $E_B^{'}=\frac{E_B}{\sqrt{1-\frac{V^2}{C^2}}}$. For the two electrified bodies after the relative motion, there will inevitably be $F_A^{'}=Q_AE_B{}^{'}=\frac{Q_AE_B}{\sqrt{1-\frac{V^2}{C^2}}}$, and there will also be $F_B^{'}=Q_BE_A{}^{'}=\frac{Q_BE_A}{\sqrt{1-\frac{V^2}{C^2}}}$. Because of $Q_AE_B=Q_BE_A$, there will inevitably be$F_A^{'}=F_B^{'}$ in terms of magnitude, that is, after the relative motion of the two electrified bodies, the constant interaction forces are equal in magnitude and opposite in direction.

It is known that, when the electric field is stationary, the energy per unit volume of the electric field is: $W=\varepsilon_0\frac{E^2}{2}$. According to the formula (3), after the relative motion of the electric field, the energy will be increased to:

$$W'=\varepsilon_0\frac{E'^2}{2}=\frac{\varepsilon_0E^2}{2\left(1-\frac{V^2}{C^2}\right)}.$$

Since $\frac{1}{\left(1-\frac{V^2}{C^2}\right)}$ can be expanded to $1+\frac{V^2}{C^2}+\frac{V^4}{C^2}+...$by series, the velocity of motion of the general electric field is much slower than the velocity of light, so $\frac{V^4}{C^4}$ and the following items can be ignored in the expansion equation, there will be $\frac{1}{\left(1-\frac{V^2}{C^2}\right)}=\frac{1+V^2}{C^2}$.

$$W'=\frac{\varepsilon_0E^2}{2}\left(1+\frac{V^2}{C^2}\right)=W+\frac{\varepsilon_0E^2V^2}{2C^2}.$$

In the previous formula (1)$B=\varepsilon_0\mu_0\times V\cdot E$, under the conditions of $V\perp E$, the formula (1) can be written as a scalar formula $B=\varepsilon_0\mu_0VE$, so there will be $V^2E^2=\frac{B^2}{\varepsilon_0^2}\mu_0^2$; because of $\varepsilon_0\mu_0=\frac{1}{C^2}$, there will be $V^2E^2=B^2\frac{C^2}{\varepsilon_0}\mu_0$; as a result of$B=\mu_0H$, there will be $V^2E^2=\mu_0H^2\frac{C^2}{\varepsilon_0}$.

$$W'=W+\frac{\mu_0H^2}{2}. \quad (4)$$

Obviously, $\frac{\mu_0H^2}{2}$ is the so-called magnetic field energy. Therefore, as expressed by the formula (4), the energy increased when the electric field is in motion is the magnetic field energy, or the magnetic field energy is the kinetic energy of the moving electric field.

The above formula (1) indicates that the magnetic field is an electric field being in motion, and that the magnetic field is not a new substance independent of the electric field. The formula (3) further proves that the so-called

energy of the magnetic field is essentially the kinetic energy of the moving electric field. It is also shown that the electric field being in motion will inevitably have the result of the contraction of electric field in the direction of motion, while the contraction of electric field will inevitably lead to the change of electric field distribution, and the change of electric field strength is the fundamental cause of the generation of electric field force. In conclusion, our comprehensive definition of the magnetic field is that, the magnetic field is the electric field contracting in motion. This point of view is the basic principle for analyzing the electromagnetic phenomena. The formula (1) for expressing this point of view can be used to calculate the magnitude of the magnetic field. The formula (3) can be used to calculate the force generated by the magnetic field. The formulas (1) and (3) are the basic formulas for deducing and analyzing all the laws of electromagnetics.

3. Derivation and Analysis of the Interaction Force of the Parallel Current and the Lorentz Force

The different observers will have the different results of analysis of the same thing. For example, in fact, there is only an electrostatic acting force between the two relatively static electrified bodies A and B. However, in the view of an observer being in motion at velocity$V$, the electrified body A is moving at velocity -V; the electric field strength of the electrified body A being in motion at velocity -V at Section B will be increased to $E'=\frac{E}{\sqrt{1-\frac{V^2}{C^2}}}$ by the contraction of E when static. As a result, the force applied to B will also inevitably be increased. Obviously, this is not true. It can thus be seen that, the observer must be discarded when analyzing the interaction of the two electrified bodies. Only the relationship and the physical factors between the two electrified bodies are analyzed. This analysis method is the basic principle for analyzing all the problems below.

3.1. Interaction Force between the Two Parallel Current-carrying Wires

According to electrostatics, it is pointed out that, if the electron density per unit length of a linear electrified body is expressed byτ, the electric field strength at Section r outside the electrified body is:

$$E=k\frac{2\tau}{r}r_0$$

(r_0- the unit vector in the r direction)

The current in the wire is equivalent to the current in the negatively-charged linear electrified body moving at velocity$V$ relative to the wire. According to the formula (3), for a static wire, the contracted and increased electric field strength is as follows:

$$E'=\frac{E}{\sqrt{1-\frac{V^2}{C^2}}}=\frac{K2\tau r_0}{r\sqrt{1-\frac{V^2}{C^2}}}. \quad (5)$$

The interaction force between the two parallel current-carrying wires will be analyzed by referring to the formula (5) according to the relative velocity between the two electrified bodies as follows.

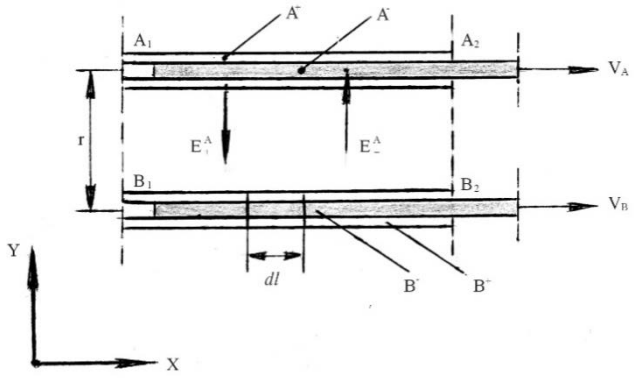

Figure 4. Interaction force of parallel wires with currents

A_1A_2 and B_1B_2 indicate one section of two parallel infinite straight leads respectively, as shown in Figure 4. The wire with current is described by using the pipeline and the flux in order to clarify clearly, wherein the flux indicates the free electron beam (current) of macro motion in the wire with current; and the pipeline indicates the proton having the electricity equivalent to that of the free electrons.

In order to facilitate analysis, suppose that the velocities of movement of the free electrons of the pipeline A are V_A, the velocities of movement of the free electrons of the pipeline B are V_B, the linear charge density of the free electrons of the pipeline A are τ_A^- and the linear charge density of the free electrons of the proton pipeline areτ_A^+, $\tau_A^-=-\tau_A^+$ obviously; and as for the pipeline B, $\tau_B^-=-\tau_B^+$ similarly.

The positive electricity $dQ_+=\tau_B^+dl$ and the negative electricity $dQ_-=\tau_B^-dl$ in dl after analyzing the acting force of one section of micro lead dl on the lead A on the lead B which has the distance far from the lead A. It can be seen from dQ^+ in dl, the field strength of the electrostatic field generated by A^+ shall be $E_{Q+}^{A+}=K2\tau_A^+(-Y_0)/r$ (the unit vector in the directionY_0-r); and seen from dQ_+, one electric field moving at the speed $V_A$is generated by the free electronA^-, and the field strength should be ($\tau_A^-=-\tau_A^+$) according to the Formula (5)

$$E_{Q+}^{A-}=K2\frac{\left(-\tau_A^+\right)}{r}\cdot\frac{-Y_0}{\sqrt{1-V^2/C^2}}=K\frac{2\tau_A^+}{r}\cdot\frac{Y_0}{\sqrt{1-V_A^2/C^2}}.$$

Therefore, the total field strength felt by dQ_+ should be

$$E_{Q+}=E_{Q+}^{A+}+E_{Q+}^{A-}=2K\tau_A^+\left(\frac{1}{\sqrt{1-V_A^2/C^2}}-1\right)\frac{Y_0}{r}.$$

dQ_+ shall be attracted by the lead A if $E_{Q+}$was positioned in the direction Y_0 obviously. V_A^4/C^4. V_A^6/C^6 … can be ignored because dQ_+ can be expanded according to the above-mentioned series as $1+V_A^2/2C^2+3V_A^4/8C^4+5V_A^6/16C^6+\ldots$, V_A/C which is minimal because of $1/\sqrt{1-V_A^2/C^2}$; therefore, the last formula could be transformed into

$$E_{Q+}=2K\tau_A^+\left(1+V_A^2/\left(2C^2-1\right)\right)Y_0/r=K\tau_A^+V_A^2\,Y_0/C^2r.$$

And the force exerted to dQ_+ shall be

$$dF_{Q+}=EdQ_+=E\tau_B^+dl=K\tau_A^+\tau_B^+dlV_A^2Y_0/C^2r.$$

Then seen from the internal part of *dl*, the field stress dF_{Q-} from A is exerted to the free electron dQ_-; and as for dQ_-, A^+moves at the speed V_B; therefore, the field strength generated by A^+ to dQ_- shall be

$$E_{Q-}^{A+}=2K\tau_A^+(-Y_0)/r\sqrt{1-V_B^2/C^2}.$$

The formula can be simplified as

$$E_{Q-}^{A+}=2K\tau_A^+(-Y_0)(1+V_B^2/2C^2)/r$$

after being expanded according to the above-mentioned series.

Then seen from the field generated by A^- to dQ_-, the interaction of A^- and dQ_- must be analyzed in accordance with the relative speeds thereof on the basis of explanation in previous 3.4, and the velocity of movement of A^- opposite to dQ_- is V_A-V_B; therefore, the field strength generated by A^- opposite to dQ_- shall be

$$\begin{aligned}E_{Q-}^{A-}&=2K\left(-\tau_A^+\right)(-Y_0)/r\sqrt{1-\left(V_A-V_B\right)^2/C^2}\\&=2K\tau_A^+Y_0\left[1+\left(V_A^2-V_B^2\right)/2C^2\right]/r.\end{aligned}$$

The total field strength of A exerted to dQ_- shall be

$$\begin{aligned}E_{Q-}&=E_{Q-}^{A+}+E_{Q-}^{A-}\\&=2K\tau_A^+Y_0\left(V_A^2-2V_AV_B+V_B^2-V_B^2\right)/2C^2r\\&=K\tau_A^+Y_0\left(V_A^2-2V_AV_B\right)/C^2r.\end{aligned}$$

The acting force exerted to dQ_- shall be

$$\begin{aligned}dF_{Q-}&=E_{Q-}dQ_-\\&=K\tau_A^+\left(-\tau_B^+\right)dlY_0\left(V_A^2-2V_AV_B\right)/C^2r\\&=-K\tau_A^+\tau_B^+dlY_0\left(V_A^2-2V_AV_B\right)/C^2r.\end{aligned}$$

The total force exerted to dQ_+ and dQ_- in $dl$from A shall be

$$\begin{aligned}dF&=dF_{Q+}+dF_{Q-}\\&=K\tau_A^+\tau_B^+dlY_0\left[V_A^2-\left(V_A^2-2V_AV_B\right)\right]/C^2r\\&=2K\tau_A^+\tau_B^+V_AV_BdlY_0/C^2r.\end{aligned}$$

Because $\tau_A^+V_A=I_A$, $\tau_B^+V_B=I_B$ and $K=1/4\pi\varepsilon_0$, $\varepsilon_0\mu_0=1/C^2$ $(K/C^2)=\mu_0/4\pi$, the last formula can be transformed into

$$dF=\frac{\mu_0}{4\pi}\cdot\frac{2I_AI_Bdl}{r}Y_0.$$

And the force Fl exerted to the lead with length of l long of the Bwire with current shall be

$$F_l=\int_0^l dF=\frac{\mu_0}{4\pi}\cdot\frac{2I_AI_Bl}{r}Y_0. \quad (6)$$

The Formula (6) indicates that F_l is located in the direction Y_0, that is, the lead B is attracted and guided by A if the directions of the currents I_A and I_B are the same; $F_l$is located in the direction$-Y_0$ and the lead B shall be repelled by A if the directions of the currents I_A and I_B are opposite, [the previous (V_A-V_B) shall be changed as V_A+V_B and F_l is changed as the negative value]. Moreover, this formula is in line with the actual condition indeed obviously.

The above-mentioned V_A and V_B are the average velocities of movement of the free electron in the leads A and B; the formula (6) shall be still valid if the analysis is implemented according to the actual motion situation of electron, as explained below:

Suppose that I_A is composed of m groups of micro current beams ΔI_{A1}, $\Delta I_{A2}\ldots\Delta I_{Am}$ having identical free electron speed, $I_A=\sum_{i=1}^m\Delta I_{Ai}$ inevitably; similarly in terms of $I_B=\sum_{j=1}^n\Delta I_{Bj}$, the interaction of all micro current beams in I_A and I_B shall be in line with the Formula (6) because the interaction of any two micro current beams ΔI_{Ai} and ΔI_{Bj} in I_A and I_B are in line with the Formula (6).

$F_l=\frac{\mu_0 2l}{4\pi r}Y_0\sum_{i=1}^m\sum_{j=1}^n\Delta I_{Ai}\Delta I_{Bj}$ shall be valid inevitably; while $\sum_{i=1}^m\sum_{j=1}^n\Delta I_{Ai}\Delta I_{Bj}=I_AI_B$, that is, the Formula (6) shall also be valid, namely, the uneven distribution of the velocities of the free electrons will not affect the Formula (6).

3.2. Derivation and Analysis of the Lorentz Force

In practice, the common rectangular current-carrying coil and the rectangular permanent magnet can be seen as a planar electron moving in a fixed direction from the analysis of the effect of the magnetic field. For a rectangular current-carrying coil, the four planes of the rectangular coil can be regarded as a current panel. If the rectangular coil is composed of n circles of wires, there is the current intensity ofnI on each panel (I - according to the current intensity of the wire). For a rectangular permanent magnet, it can also be regarded as a rectangular current-carrying coil. In the following analysis, the electric field generated by the moving electron or the proton with the isoelectric quantity on the four current panels of a coil or magnet can be approximately regarded as a uniform electric field.

One infinite panel which is charged uniformly shall generate the electric field that is distributed uniformly; and the previous 3.2 points out the field strength E of the uniform electric field shall be increased as $E'=E/\sqrt{1-V^2/C^2}$ inevitably when the uniform electric field moves at the speed V in any direction. In the reality, the

usual rectangle cut-off coil and the rectangle permanent magnet we see can be taken as the surface charges moving along one fixed direction in the plane. As for the rectangle current-carrying coil, the four sides of the rectangle coil can be taken as the current panels; suppose that the rectangle coil is composed of n turns of lead, each panel shall have the current density of *nI* (I indicates the current strength of each lead); as for the rectangle permanent magnet, the four surfaces thereof can be taken as four current panels, that is, be similar to the rectangle current-carrying coil. Moreover, the Lorentz force and the permanent magnet shall be analyzed according to the explanation of the above-mentioned current panel.

4.3.1. Analysis of Lorentz Force

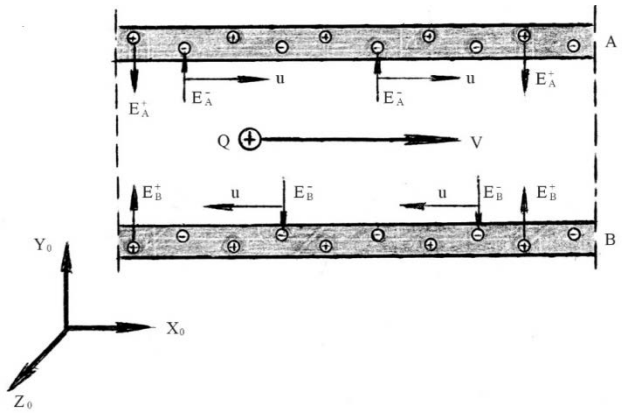

Figure 5. Analysis of source of Lorentz force

A and B indicate two current surfaces composed of the infinite wires with currents; the two current surfaces of A and B shall be composed of the common wire with current, as shown in Figure 5, wherein the currents of A and B are equal and opposite in direction. E_A^- and E_B^- in the figure indicate the field intensities generated by the negative moving electrons in the current surface, respectively; while E_A^+ and E_B^+ indicate the field intensities generated by the positive static electrons having electricities equal to that of the negative electron, respectively.

The magnetic induction strength among two current surfaces of A and B should be acquired first; from the Formula (1) $B = \mu_0 \varepsilon_0 V \times E$, B is from the moving electric field; motionlessness of E_A^+ and E_B^+ is related to B, and the E_A^- electric field moving at the speed $\boldsymbol{u}$ and the E_B^- electric field moving at the speed $-\boldsymbol{u}$ shall be analyzed. Moreover, E_A^- and E_B^- are equal and opposite in direction obviously, that is, $E_B^- = -E_A^-$, wherein E indicate the absolute values of E_A^- and E_B^-.

The magnetic induction strength B_A generated by E_A^- shall be calculated; and from the Formula (1),

$$B_A = \mu_0 \varepsilon_0 u \times E_A^- = \mu_0 \varepsilon_0 u E Z_0$$

(Z_0 refers to the unit vector in the direction$Z$)

The feeling strengthB_B generated by E_B^- shall be

$$B_B = \mu_0 \varepsilon_0 (-u) \times E_B^- = -\mu_0 \varepsilon_0 u (-E_A^-) = \mu_0 \varepsilon_0 u E Z_0$$

The total feeling strength generated by two current surfaces of A and B shall be:

$$B = B_A + B_B = 2\mu_0 \varepsilon_0 u E Z_0$$

Q indicates that the particle having positive charge moves parallel with the two current surfaces at speed V, as shown in Figure 5. Moreover, the Lorentz force exerted to Q according to the formula of Lorentz force in the field of electromagnetism should be:

$$F = QV \times B = 2\mu_0 \varepsilon_0 V u E Q(-Y_0) \qquad (7)$$

(Y_0 refers to the unit vector in the direction Y).

The Formula (7) shall be the expression of electromagnetism for the Lorentz force in the presence of Figure 5. It should be started from the source of stress on Q when we analyze the source of Lorentz force. The stress on Q is exclusively because of action of the electric field unquestionably. Four electric fields including E_A^+, E_B^+, E_A^- and E_B^- exist among two current surfaces of A and B, but the acting forces of E_A^+ and E_B^+ to Q are constant equal and opposite in direction; the effects thereof to Q are not required to taken into account because the acting forces offset each other. Moreover, E_A^- and E_B^- shall be the only sources of the stress on Q when E_A^+ and E_B^+ are excluded.

The relative speeds of E_A^-, E_B^- and Q shall be confirmed before analyzing the interaction of E_A^-. E_B^- and Q in accordance with the rule of relative velocity; and it can be seen that the relative speeds of E_A^- and Q are $V - u$ usually, and the relative speeds of E_B^- and Q are $V + u$. However, this kind of velocity addition method shall not be applicable when the velocity of motion of Q is great; and the theory of relativity pointed out that the composition of velocities of the theory of relativity should be taken for composition of velocities of the objects moving at high speed. Our analysis conclusion should be applicable both for the object moving at low speed and the object moving at high speed in view of the principle of being applicable comprehensively. Therefore, we should calculate the relative velocity by using the composition of velocities of the theory of relativity.

The composition of velocities of the theory of relativity shall include the composition of velocities in directions X, Y and Z. As for Figure 5, the speed in direction Z does not exist; the extremely small migration velocity exists in the direction Y and can be ignored. Therefore, the composition of velocities in the direction X shall be analyzed, wherein the formula for composition of velocities in the direction X shall be:

$$V_X = \frac{u_x + \omega}{1 + u_x \omega / C^2}.$$

In the formula, ω refers to the inertial system Z which is static with respect to the object M, and by which the velocity of motion of another inertial system Z' can be observed; u_x refers to the velocity of motion of object N with respect to Z'; Vx refers to the relative speeds of M and N. As for the current surface of A in the Figure 5, the force exerted to Q (object M) shall be acquired; Q belongs to the inertial system Z, and A belongs to the inertial system Z'; and the velocity of motion of the Z' (A and B) is -V from Z, that is, $\omega = -V$ in the composition formula; the velocity of motion of E_A^- (object N) is u from Z', that is, $u_x = u$ in the composition formula. Therefore, the velocity of motion of Q with respect to E_A^- should be:

$$V_A = \frac{u-V}{1+uV/C^2}.$$

Similarly, the velocity of motion of Q with respect to E_B^- should be:

$$V_B = \frac{-u-V}{1+uV/C^2}.$$

Een from Q, E_A^- moving at speed V should be contracted and increased as

$$E_A^{-'} = E_A^- / \sqrt{1-V_A^2/C^2}$$

$$= \frac{E_A^-}{\sqrt{1-\left(\frac{u-V}{1-uV/C^2}\right)^2}/C^2}$$

$$= \frac{E_A^-}{\sqrt{1-\frac{C^4(u-V)^2}{\left(C^2-uV\right)^2}}/C^2}$$

$$= \frac{\left(C^2-uV\right)E_A^-}{\sqrt{\left(C^2-uV\right)^2 C^2(u-V)^2}}$$

$$= \frac{\left(C^2-uV\right)E_A^-}{\sqrt{C^4+u^2V^2-C^2u^2-C^2V^2}}$$

$$= \frac{\left(C^2-uV\right)E_A^-}{\sqrt{\left(C^2-V^2\right)\left(C^2-u^2\right)}}$$

$$= \frac{\left(C^2-uV\right)E_A^-}{C^2\sqrt{\left(1-V^2/C^2\right)\left(1-u^2/C^2\right)}}.$$

Because the velocities u of the negative electrons of the two current surfaces of AB are far smaller than C (the revolving speed of the electron of magnetic domain is also far smaller than C), u^2/C^2 is very small, and it can be considered that $1-u^2/C^2 \approx 1$, the formula above can be simplified as:

$$E_A^{-'} = \frac{\left(C^2-uV\right)E_A^-}{C^2\sqrt{1-V^2/C^2}}.$$

E_B^- moving at speed V should be contracted and increased as: $E_B^{-'} = E_B^-/\sqrt{1-V_B^2/C^2}$; and when the previous V_B is substituted, the formula below can be acquired:

$$E_B^{-'} = \frac{E_B^-}{\sqrt{1-\left(\frac{u+V}{1+uV/C^2}\right)^2}/C^2}$$

$$= \frac{E_B^-}{\sqrt{1-\frac{C^4(u+V)^2}{\left(C^2+uV\right)^2}}/C^2}$$

$$= \frac{\left(C^2+uV\right)E_B^-}{\sqrt{\left(C^2+uV\right)^2-C^2(u+V)^2}}$$

$$= \frac{\left(C^2+uV\right)E_B^-}{\sqrt{\left(C^2-V^2\right)\left(C^2-u^2\right)}} = \frac{\left(C^2+uV\right)E_B^-}{C^2\sqrt{1-V^2/C^2}}.$$

The total field strength felt by Q should be

$$E' = E_B^{'} + E_A^{'} = \frac{\left(C^2+uV\right)E_B^{'}}{C^2\sqrt{1-V^2/C^2}} + \frac{\left(C^2-uV\right)E_A^-}{C^2\sqrt{1-V^2/C^2}}.$$

Because $E'^-_A = -E_B^-$, the formula:

$$E' = \frac{2uVE_B^-}{C^2\sqrt{1-V^2/C^2}} = \frac{2\mu_0\varepsilon_0 uVE}{\sqrt{1-V^2/C^2}}(-Y_0) \qquad (8)$$

can be obtained upon simplification after substituting $E'^-_A = -E_B^-$ into the formula above.

The force exerted to Q when moving at high speed in the magnetic field shall be indicated by usingF_V in order to distinguish the acting force $\boldsymbol{F}$, that is, Lorentz force defined electromagnetically of Q when moving at low speed in the magnetic field, and the formula below can be acquired from the Formula (8):

$$F_V = E'Q = \frac{2\mu_0\varepsilon_0 uVEQ}{\sqrt{1-V^2/C^2}}(-Y_0). \qquad (9)$$

It can be seen after comparing this formula with the Formula (10) of Lorentz force that:

$$F_V = \frac{F}{\sqrt{1-V^2/C^2}}. \qquad (10)$$

By comparing the formula (10) with the Lorentz force formula (7), it can be seen that, when V is smaller, $\sqrt{1-\frac{V^2}{C^2}} \approx 1$. F_V and F will be basically the same; however, when V is larger, $\sqrt{1-\frac{V^2}{C^2}}$ will inevitably be significantly less than 1. There are the significantly different results calculated according to the formula (10) and (7). For example, when V =0. 866C, there is $\sqrt{1-\frac{V^2}{C^2}} = 0.5$, i.e.$F_V = 2F$. If $V$is larger, the difference between F_V and F will be greater. So, which of the formulas (10) and (7) is scientific and practical? Obviously, it can be identified by the practical results for

applying the force to the electron being in high-velocity motion.

When the charged ions is moving at velocity V in the magnetic field, the acceleration $a=\frac{F}{m}$ (m-ion mass) will inevitably be generated in the direction perpendicular to$V$ under the action of the Lorentz force$F$. After the time t, the deflection distance of the ion in the direction perpendicular to$V$ is $Y=\frac{at^2}{2}=\frac{Ft^2}{2m}$. Experiments have confirmed that this result of calculation is in line with reality if V is not large, but if $V$is larger, the experimental result is:

$$Y'=\frac{Ft^2\sqrt{1-\frac{V^2}{C^2}}}{2m}. \tag{11}$$

How to explain this experimental result? It is interpreted according to general physics that, based on the special theory of relativity, since the mass of ion will inevitably be increased to $m'=\frac{m}{\sqrt{1-\frac{V^2}{C^2}}}$ when the ion is in high-velocity motion, so the formula Y has become the formula (11). However, it is assumed according to Berkeley physics that $m$fails to be transformed, and the time t is transformed into $t'=t\sqrt{1-\frac{V^2}{C^2}}$. The formula (11) can also be obtained from the change of quantity of ion motion.

It is pointed out according to the special theory of relativity that, the mass$m$, time$t$ and length$l$ of a moving object are transformed simultaneously. Only the transformation of m or t should be one-sided wrong. Therefore, it is obviously unscientific to explain a decrease in the deflection distance of the charged ion being in high-velocity motion in the magnetic field only by mass or time transformation. If the deflection problem is explained only by the Lorentz force, there will inevitably be $Y'=\frac{Ft^2\left(1-\frac{V^2}{C^2}\right)^{\frac{3}{2}}}{2m}$ under the conditions of comprehensive transformation. This result is undoubtedly wrong. It is proved that, it is impossible to reasonably explain the deflection problem of the charged ion at the different velocity of motion in the magnetic field only by the Lorentz force. It is proved below that, this problem can be scientifically explained by the formula (10) F_V.

It is known that, $m'=\frac{m}{\sqrt{1-\frac{V^2}{C^2}}}$, $t'=\frac{t}{\sqrt{1-\frac{V^2}{C^2}}}$ and the length $l'=l\sqrt{1-\frac{V^2}{C^2}}$ should be comprehensively transformed. Due to $t'=\frac{l'}{V}$, that is, $t\sqrt{1-\frac{V^2}{C^2}}=\frac{l\sqrt{1-\frac{V^2}{C^2}}}{V}$ when the charged particle is in high-velocity motion, the transformation of the length (the width of magnetic field) has already been included in the time transformation. Moreover, the force should also be transformed, and the transformation formula of known force should be:

$$F'=\frac{F\sqrt{1-\frac{\cos^2\theta V^2}{C^2}}}{\sqrt{1-\frac{V^2}{C^2}}}.$$

In the formula, θ represents the included angle between F and V (see Reference 2.4). Since the direction of force$F$ applied to the charged particles is perpendicular to $V$and$cos\,\theta=0$, so:

$$F'=\frac{F}{\sqrt{1-\frac{V^2}{C^2}}} \tag{12}$$

Although the formula (12) is not currently a recognized formula, from the recognized electrodynamically-determined distribution formula of the electric field strength of the charged particle being in high-velocity motion,

$$E'=k\frac{1-\frac{V^2}{C^2}}{\left(1-\frac{V^2\sin^2\theta'}{C^2}\right)^{\frac{3}{2}}}\cdot\frac{Q}{r'^2}. \tag{13}$$

The formula (12) can be obtained as well. In the formula (13), θ' indicates the included angle between $E'$and$V$. Since the electric field force$E'Q$ is perpendicular to V and$E'\perp V$, there is$sin\,\theta'=1$, so the formula (13) is transformed into $E'=\frac{kQ}{\sqrt{1-\frac{V^2}{C^2}}}\cdot r'^2$. Since $E=\frac{kQ}{r'^2}$ indicates the electric field strength at Section r', so there is $E'=\frac{E}{\sqrt{1-\frac{V^2}{C^2}}}$, and the electric field force is proportional to the electric field strength. Therefore, under the conditions of $E'\perp V$, the formula (13) is consistent with the formula (12).

It is pointed out by the above formula (10) that, if $F_V=\frac{F}{\sqrt{1-\frac{V^2}{C^2}}}$ (current F) is transformed into $F'=\frac{F}{\sqrt{1-\frac{V^2}{C^2}}}$, there will inevitably be

$F_V^{'} = \frac{F'}{\sqrt{1-\frac{V^2}{C^2}}} = \frac{F}{\left(1-\frac{V^2}{C^2}\right)}$. After substituting F_V', $m' = \frac{m}{\sqrt{1-\frac{V^2}{C^2}}}$ and $t' = \frac{t}{\sqrt{1-\frac{V^2}{C^2}}}$, into $Y = \frac{Ft^2}{2m}$ for a comprehensive transformation, we can obtain:

$$Y' = \frac{F_V^{'} t^{'2}}{2m'} = \frac{Ft^2\sqrt{1-\frac{V^2}{C^2}}}{2m}.$$

Obviously, this comprehensively-transformed deduced result is consistent with the measured results.

The deflection of the charged particle being in high-velocity motion in the magnetic field is resulted from the interaction between the magnetic field and the charged ion. As mentioned above, the correct analysis results have been obtained under conditions of the static magnetic field based on F_V. And then, the further analysis is carried out under the conditions of the static charged particle and the magnetic field moving at high-velocity -V based on F_V, and the same analysis results should be obtained as well.

From the perspective of the relatively static particle, when the particle is static, $m$will not be transformed; F_V will neither move nor transform, but the length of the magnet with the width of l in the direction of$V$ will be shortened to $l' = l\sqrt{1-\frac{V^2}{C^2}}$; the time required for the magnet (magnetic field) to pass through the particle will be $t' = \frac{l'}{V} = \frac{l\sqrt{1-\frac{V^2}{C^2}}}{V = t\sqrt{1-\frac{V^2}{C^2}}}$; after substituting the unchanged m & $F_V = \frac{F}{\sqrt{1-\frac{V^2}{C^2}}}$ and transformed $t' = \frac{t}{\sqrt{1-\frac{V^2}{C^2}}}$ into $Y = \frac{F_V t^2}{2m}$ for transformation, $Y' = \frac{Ft^2\sqrt{1-\frac{V^2}{C^2}}}{2m}$ can be obtained. This result is also consistent with the measured results.

It should be noted that the formula (10) is only the analysis result obtained under the condition of uniform magnetic field. Therefore, the formula (10) is not applicable to the non-uniform magnetic field.

3.3. The Constant Velocity of Light is the Source of Magnetism

According to the basic principle of the contraction of the electric field in the direction of motion, the intrinsic cause for the generation of the Lorentz force is proved by derivation; the problem of a decrease in the deflection distance of the charged particle being in high-velocity motion in the magnetic field is interpreted scientifically and reasonably by the comprehensive transformation of the Lorentz force; the problem of the interaction between the two parallel current-carrying wires is proved by derivation; the contradiction between the different observers with the different interpretations is eliminated. The phenomenon of heteropolar attraction and homopolar repulsion between the permanent magnets can be interpreted by the formula (12) $F' = \frac{F}{\sqrt{1-\frac{V^2}{C^2}}}$. Since $\frac{1}{\sqrt{1-\frac{V^2}{C^2}}}$ can be expanded to $1+\frac{V^2}{2C^2}+\frac{3V^4}{8C^2}+\frac{5V^6}{16C^6}...$ by series, $V$is smaller relative to C, so $\frac{3V^4}{8C^2}$ and the following items can be ignored, there will be $F' = \frac{F}{\sqrt{1-\frac{V^2}{C^2}}} = F\left(1+\frac{V^2}{2C^2}\right) = F + F\frac{V^2}{2C^2}$. For ease of explanation, $\Delta F = F\frac{V^2}{2C^2}$ is set. When analyzing the interaction force between the permanent magnets, the electrostatic repulsion and the electrostatic attraction can be ignored, because the two forces are generally balanced, only ΔF can be analyzed.

When the heteropoles of the permanent magnets A and B are opposite, the direction of rotation of electrons on the polar planes A and B is the same. It can be considered that the electrons on the two polar planes are relatively static. Only the electrostatic repulsion can be ignored. Relative to the proton with the equivalent electric quantity on the polar plane A, the electron on the polar plane B is moving at the velocity V to generate an attraction ΔF. Moreover, Relative to the electron on the polar plane A, the proton with the equivalent electric quantity on the polar plane B is moving at the relative velocity V to generate an attraction ΔF. The total effect is that the polar plane B is attracted by the polar plane A$2\Delta F$. When the homopolar planes of two permanent magnets A and B are relative to each other, the directions of rotation of the electrons on the two polar planes are opposite. It can be considered that the relative velocity of the electrons on the two polar planes is $2V$. In this case, the velocity of relative motion of the electron on the polar plane B relative to the proton with the equivalent electric quantity on the polar plane A or the proton with the equivalent electric quantity on the polar plane B relative to the electron on the polar plane A is still V, so the attraction$2\Delta F$ of the two remains unchanged. However, the velocity of relative motion of the electrons on the two polar planes is $2V$, so the repulsive force between the electrons is $F' = \frac{F}{\sqrt{1-\frac{4V^2}{C^2}}} = F + \frac{4FV^2}{2C^2} = F + 4\Delta F$. Repulsion is in the opposite direction of attraction. This $4\Delta F$ is the

attraction $4\Delta F$-. Therefore, in this case, the resultant force of the two permanent magnets A and B is 2ΔF-4ΔF=-$2\Delta F$, i.e. the polar plane B is subjected to the repulsive force of the polar plane A$2\Delta F$. The comprehensive conclusion is that the attraction generated by the relative heteropolar polar planes of the two permanent magnets is equal to the repulsion of generated by the relative homopolar polar planes of the two permanent magnets.

It is pointed out in Section 2.4 that, the interpretation of the interaction force between the rectangular current-carrying coil and the moving electric charge (as shown in Figure 3C) violates the law of counter-acting force. However, this interpretation should be carried on by the principle of contraction of electric field in the direction of motion. The results of analysis indicate that, there will inevitably be the same magnitude and the opposite direction of the velocity of relative motion, the same contraction ratio of the electric field, the equal magnitude and the opposite direction of the acting force and the counter-acting force between the electrons and protons of the moving electric charge and the current-carrying coil. The comprehensive derivation conclusion will inevitably be consistent with the law of counter-acting force.

It is the most powerful evidence for proving that the principle of electromagnetics is defective, and that the magnetic field is indeed an electric field contracting in motion as follows: It is confirmed by experiments that, there are negative electrostatic field strengths of about 240V/m and 130V/m at 10mm and 20mm near the four seamed edges of the planes N and S of a cubic NdFeB permanent magnet with a side length of 2 cm and a surface magnetic induction strength of about 0.8 T, respectively, and that there are positive electrostatic field strengths of about 200V/m and 100V/m at 10mm and 20mm beside the four seamed edges of the sides of such cubic NdFeB permanent magnet, respectively (see Reference 1.4). This fact has not only completely negated the conclusion on the existence of an electrostatic field only around an electrified body in electromagnetics, but also is an experimental result that cannot be interpreted by electromagnetics. However, a scientific and reasonable interpretation can be made according to the principle of contraction of the electric field in the direction of motion. Because of the comprehensive and concrete analysis, it is necessary not only to calculate the moving electric field of all the moving electrons to a certain point in space on the four sides of the rectangular permanent magnet, but also consider that the magnetic domain electrons in the permanent magnet are in rotating motion rather than in linear motion. Therefore, as a result of the lengthy analysis and explanation are lengthy, there is no introduction here. Here, only the principle of contraction of the electric field in the direction of motion is applied to make a simple and clear qualitative explanation of the experimental results.

Figure 6(a) shows the uniform distribution of electric field when the charge is static. Figure 6 (b) shows the contraction of electric field when the electric charge is moving at the high-velocity of 0.866C in the X direction. It can be seen that, after the high-velocity motion of the electric charge, the line of electric force is densely concentrated in the Y direction, that is, the electric field strength in the Y direction is increased, while the line of electric force is sparsely dispersed in the X direction, that is, the electric field strength in the X direction is decreased. The distribution of the electric field generated by the charged particles being in high-velocity motion is clarified in the formula (13). The formula (13) can also be derived according to the geometric variation of the line of electric force as shown in Figure 6 (b).

The cubic permanent magnet is indicated by a rectangular tubular current-carrying coil as shown in Figure 6(c). One of the abcd planes of this coil is analyzed separately, on which all the electrons will move in the x direction. As shown in Figure 6 (b), the electric field generated by the electrons is densely concentrated in the Y direction, that is, the electric field strength is increased, while the electric field is sparsely dispersed in the X direction, that is, the electric field strength is decreased. Therefore, the negative electric field strength in the Y direction will inevitably be greater than the strength of positive electric field generated by the proton with the same electric quantity with the electron, so that the resultant result is bound to present a negative electrostatic field. However, since the strength of negative electric field generated by the electrons is decreased, the negative electric field strength in the X direction will inevitably be smaller than the strength of positive electric field generated by the proton with the same electric quantity with the electron, so that the resultant result is bound to present a positive electrostatic field. Thus, it can be understood why there is a negative electrostatic field near the edge on the plane N or S of the permanent magnet (i.e. in the Y direction), and why there is a positive electrostatic field near the edge on the side of the permanent magnet (i.e. in the X direction).

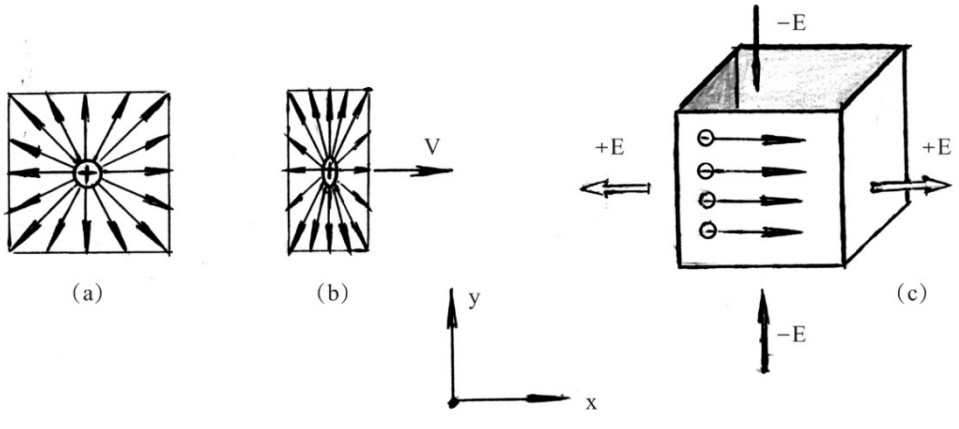

Figure 6. An electrostatic electric field generated by the permanent magnet caused by the contraction of the electric field in the direction of motion

It is shown by the above analysis that, according to the basic principle of contraction of the electric field in the direction of motion, all the magnetic phenomena are interpreted scientifically and reasonably; the defects in wrong or unscientific interpretations of some magnetic phenomena by electromagnetics are eliminated; the electrostatic field phenomena which is impossible to be interpreted by electromagnetics and which exist around the permanent magnet can also be interpreted scientifically and reasonably. It is fully shown that, the basic principle of contraction of the electric field in the direction of motion truly and scientifically reflects the nature of magnetism, and this also means that the contraction of the electric field in the direction of motion is the source of magnetic force. Well, if there is no law of the contraction of the electric field in the direction of motion, then the electric field generated by the moving electrons in the current-carrying wire is unlikely to have a contraction enhancement effect. That is to say, there is no difference between the current and the non-current in the wire, and there is no acting-force between the current-carrying wires. Similarly, it is found from the moving electrons in the magnetic field that, the moving electric field generated by any moving electrons in the magnet has no a contraction enhancement effect. That is to say, there is no difference between the permanent magnet and the ordinary solid and liquid in terms of the electric field variation. Naturally, there is no the Lorentz force. In conclusion, if there is no contraction of the electric field in the direction of motion, there will be no magnetic phenomenon in the universe; if there is no magnetic phenomenon, there will be no magnet, that is, there will be no magnetism. As the basis of all modern technologies such as motor, instrument, chip, automatic control and the like, magnetism has contributed the precious modernization to mankind. If there is no magnetism, there will be no modernization in human society. Therefore, it should be confirmed that the contraction of the electric field in the direction of motion is the source of modern technology. Since the contraction of the electric field in the direction of motion is derived from the special theory of relativity, the special theory of relativity is derived from the Lorentz transformation, and the Lorentz transformation is derived from the principle of constancy of light velocity that cannot be understood by normal logical thinking of human beings, so it will inevitably be concluded that the law of constancy of light velocity is the source of modernization of human science and technology. This means that the principle of constancy of light velocity is the most precious gift which the God has given to mankind!

4. Motion with Variable Velocity and Electric Wave of the Electric Field

As explained above, when the electron is in motion, the electric field generated by the electron will inevitably be accompanied by motion. Therefore, when the electron is in motion with variable velocity, the electric field generated by the electron will also inevitably be accompanied by motion with variable velocity. However, there will inevitably be a process of propagation of the variable motion condition of the electron in its electric field, that is to say, the variable motion condition of the electron will inevitably be propagated in the electric field generated by the electron at a certain velocity. It is natural to assume that this propagation velocity is the velocity of light.

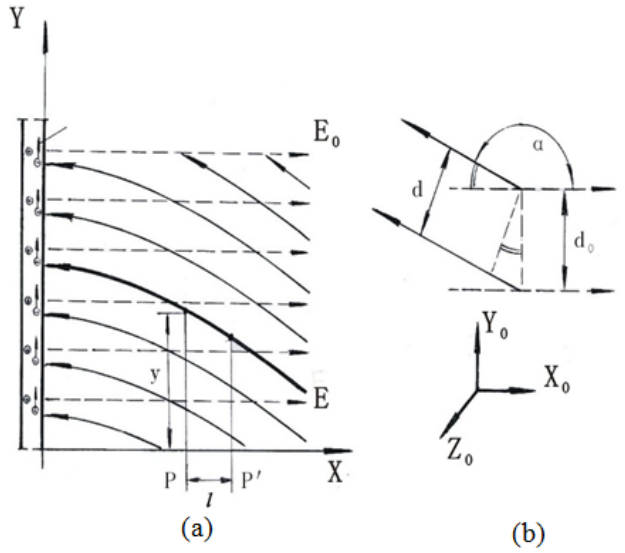

Figure 7. Distortion of power line caused by the variable motion of negative electrons

A section of "infinite" plane conductor is shown in Figure 7 (a), static positive electric field generated by the positive electric field of equivalent electric quantity with the negative electron in conductor; the dotted line indicates its power line; E_0 indicates its electric field intensity. All the negative electrons in the conductor are in the same variable motion. As pointed out above, when the electron is in variable motion, it will be propagated at the velocity of light in its generated electric field; propagation velocity: $C = dx/dt$. Given that the electron is moving along direction of Y coordinate according to the law of motion $y = f(t)$, the electron will be propagated at the velocity of light C in its generated electric field, resulting in the distortion of electric field. Line E indicates the electric field of such electrons (as shown in Figure 7 (a)). As a result of electron motion, the electron will be propagated, resulting in the distortion of power line. Given that the law of motion at Point P on the power line E is set as: $y = f(t)$, then the law of motion at PointP' at Section $l$behind Point P must be set as: $y = f(t - l/c)$. The movement velocity of electric field at Point P along the direction in Y coordinate shall be:

$$u = \frac{dy}{dt} = \frac{df(t)}{dt}. \tag{14}$$

It can be seen from Figure 7 (a) that, because of tilt, the distance between the lines E will become smaller. The relationship between the distance$d$between the tilted lines E and the distance$d_0$between the electric field lines E_0 of positive electron shall be shown in Figure 7(b). As shown in Figure 7(b), if the included angle between E and E_0 is set as α, then $d = d_0|cos\,\alpha|$. Since $cos\,\alpha$ represents a negative value, so $d = d_0(-cos\,\alpha)$. Since the electric field intensity is inversely proportional to the distance between the power lines, so the ratio of scalars between E and E_0 shall be as follows:

$$\frac{E}{E_0}=\frac{d_0}{d}=\frac{1}{-\cos\alpha}.$$

Namely, $E=-E_0/\cos\alpha\,.E$ can be decomposed into two components: One component is parallel to$x$, which is expressed by E_x; one component is perpendicular to$x$, expressed byE_y. Obviously:

$$E_x=E\cos\alpha=\frac{-E_0}{\cos\alpha}\cdot\cos\alpha X_0=-E_0X_0 \qquad (15)$$

($\boldsymbol{X_0}$—represents the unit vector along the direction of $x$coordinate).

Since E_x belongs to a moving electric field, its velocity of movement along the direction of y coordinate shall be expressed as u; the electric field is a kind of matter; according to the Special Theory of Relativity, the matter (velocity of movement: u) will be contracted in the direction of motion according to the proportion $\sqrt{1-u^2/c^2}$; therefore, E_x will be contracted in the direction of y coordinate according to the proportion $\sqrt{1-u^2/c^2}$, so that the distance between the power lines will naturally become smaller; the electric field intensity shall be inversely proportional to the distance between the power lines; as a result of contraction of electric field,$E_x$can be converted into:

$$E_x^{'}=\frac{E_x}{\sqrt{1-u^2/c^2}}=-\frac{E_o}{\sqrt{1-u^2/c^2}}X_o. \qquad (16)$$

Since there is no motion of E_y in the direction of coordinate (namely, the negative electron has not moved in the conductor along the direction of$x$coordinate), so the electric field has not been contracted in the direction of$x$coordinate. There is no any relationship between E_y and u, thus:

$$E_y^{'}=E_y=E\sin\alpha=\frac{-E_o}{\cos\alpha}\sin\alpha Y_o=-E_o tg\alpha Y_o. \qquad (17)$$

In the above formula, since$tg\alpha$represents a negative value, so $E_y^{'}$ has the same direction as $\mathbf{Y}_o$.

$$E'=E_x^{'}+E_y^{'}=\frac{-E_o}{\sqrt{1-u^2/c^2}}\cdot X_o-E_o tg\alpha Y_o. \qquad (18)$$

As can be seen from Figure 7 (a), $tg\alpha=dy/dx$. Since $u=dy/dt$,$c=dx/dt$, therefore:

$$tg\alpha=\frac{dy}{dt}\cdot\frac{dt}{dx}=\frac{u}{C}. \qquad (19)$$

Since the movement velocity of electric field of electron along the direction of Y coordinate is expressed as $u=dy/dt$, according to Section 3.1, the moving electric field shall be considered as the magnetic field. According to the above Formula (1), the following formula can be derived:

$$B=\frac{1}{C^2}\cdot u\times E=\mu_0\varepsilon_0 u\times E. \qquad (20)$$

Since$u$is much less than$C$according to the Formula (19), $tg\alpha$ shall be minimal, namely,αshall be minimal, so it can be considered that $u\perp E$. The Formula (19) can be written as the scalar formula below:

$$B=\mu_0\varepsilon_0 u\times E. \qquad (21)$$

From the above analysis, when the in-plane electron is in variable motion, it will be propagated at the velocity of light in its generated electric field, resulting in the distortion of electric field generated by the electron. As a result of distortion of electric field, there exists the electric field intensity $E_y=-E_0u/C$ in the direction of electron motion. As a result of movement velocity$u$of electric field of electron, the electric field moving at velocity$u$shall be considered as the magnetic field (magnetic induction intensity: $B=\mu_0\varepsilon_0 uE$). Obviously, the electromagnetic wave refers to the process in which E_y and B are propagated in the distorted electric field.

4.2. Energy Output of Electromagnetic Wave

As previously mentioned, there still exist the respective electric fields of positive & negative electrons in the conductor. The electric field has its electric field energy. Why does the electric field energy exist around the conductor when there is no current flowing in the conductor? Obviously, the reason is that the electric field energy of positive electron and the electric field energy of negative electron may be offset each other. It is indicated in Formula 4.1 that, when the electromagnetic wave is generated, $E=E_0/\cos\alpha$, $|E|>|E_0|$, the electric field energy of E is greater than the electric field energy of E_0. After both are offset, there inevitably exists the residual electric field energy which is the energy output of electromagnetic wave. Considering that the actual existing electric field energy is basically the electric field energy of negative electron, therefore, the electric field energy of negative electron can be defined as the positive electric field energy; the electric field energy of positive electron can be defined as the negative electric field energy. Thus, the electric field energy per unit volume in electromagnetic wave shall be the difference between the moving electric field intensity of $E^{'}$ and the static electric field energy of E_0.

$$W=\frac{\varepsilon_o}{2}\boldsymbol{E}'^2-\frac{\varepsilon_o}{2}\boldsymbol{E}_0^2=\frac{\varepsilon_o}{2}(\boldsymbol{E}_x'^2+\boldsymbol{E}_y'^2)-\frac{\varepsilon_o}{2}\boldsymbol{E}_o^2.$$

Since there is no any relationship between the size of electric field energy and the direction of E, the above formula can be written as the scalar formula. After the Formula (18) is substituted into the scalar formula, the following formula can be obtained:

$$W=\frac{\varepsilon_0E_0^2}{2\left(1-u^2/c^2\right)}+\frac{\varepsilon_o}{2}E_y^2-\frac{\varepsilon_0}{2}E_o.$$

$1/(1-u^2c^2)$ can be expanded as $1+u^2/c^2+u^4/c^4+\ldots\ldots$according to the binomial progression series. Since u is very small relative to c, so u^4/c^4 and the subsequent items can be ignored. After $1/(1-u^2c^2)=1+u^2/c^2$ is substituted into the above formula, the following formula can be obtained:

$$\begin{aligned}W&=\frac{\varepsilon_o}{2}E_o^2+\frac{\varepsilon_o u^2E_0^2}{2c^2}+\frac{\varepsilon_o}{2}E_y^2-\frac{\varepsilon_o}{2}E_o^2\\&=\frac{\varepsilon_0}{2}E_y^2+\frac{\varepsilon_o u^2E_o^2}{2c^2}=W_1+W_2.\end{aligned} \qquad (22)$$

Where, $W_1 = \varepsilon_o E_y^2/2$ represents the electric field energy per unit volume generated by the electromagnetic wave in the direction of y; $W_2 = \varepsilon_o u^2 E_o^2/2$ represents the electric field energy per unit volume generated by the electromagnetic wave in the direction of x. As a result of motion contraction, the electric field energy per unit volume will be increased. What is the relationship between W_1 and W_2? Because of $E_y = E_0 tg\alpha$, $tg\alpha = u/c$, W_2 can be transformed into:

$$W_2 = \frac{\varepsilon_o}{2} E_o^2 \frac{u^2}{c^2} = \frac{\varepsilon_o}{2} E_o^2 tg^2\alpha = \frac{\varepsilon_o}{2} E_y^2 = W_1. \quad (23)$$

It is indicated in the Formula (23) that, there is the same size of energy W_1 and W_2 propagated via the electromagnetic wave.

In the Formula (20), $B = \mu_0 \varepsilon_0 u \times E$, i.e. $uE = B/\mu_0\varepsilon_0$. Because of $\mu_0\varepsilon_0 = 1/c^2$, $B = \mu_0 H$; therefore:

$$W_2 = \frac{\varepsilon_o}{2C^2} E_o^2 u^2 = \frac{\varepsilon_o}{2}(\mu_0\varepsilon_o)\cdot\frac{B^2}{\mu_0^2\varepsilon_0^2} = \frac{B^2}{2\mu_0} = \frac{\mu_0}{2} H^2. \quad (24)$$

It is indicated In the Formula (24) that, the increased energy caused by the contraction motion of electric field is the magnetic field energy. Therefore, it is indicated in the Formula (23) that, the energy propagated via the electromagnetic wave shall be of the same size as the magnetic field energy.

4.3. Analysis of Electromagnetic Wave

From the above analysis of energy output and generation of electromagnetic wave, what is the difference between the electromagnetic wave and the electromagnetic wave introduced in Electromagnetics?

It is indicated in Electromagnetics that, the spatially-varying electric field will generate a varying magnetic field, and vice versa, the varying magnetic field will generate a varying electric field, which is called the electromagnetic wave to follow in a circle incessantly. The varying electric and magnetic fields are considered as the substances. I believe that, any substances are impossible to be produced, including the electric and gravitational fields. The varying electric field is also impossible to be generated naturally without foundation. As previously mentioned, the actually observed varying electric field refers to an effect caused by distortion of inherent electric field of electron in variable motion along with the electron from the near to the distant. Further descriptions are as follows:

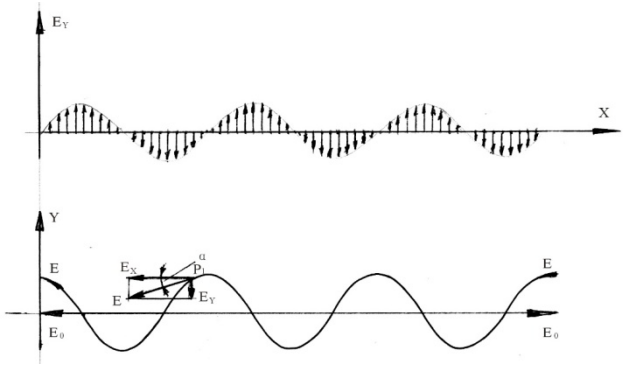

Figure 8. Description of the actual situation of electromagnetic wave

As shown in Figure 8, when the panel electron is simply harmonically vibrated, the electric field generated by the electron can be drawn by the line of electric force. The line of electric force is inevitably twisted into a cosine curve. This curve is similar to the ripple on the water surface. The electric field substances at all points on the line of electric force will be in simple harmonic motion at velocity u in the Y-direction with the electron one after another, which will not move in the X direction. As shown in Figure 8, the field strength at any point P on the line of electric force (in the tangential direction of the point P) is indicated by E (i.e. the aforementioned deformation of E_0); the component of E in the Y direction is indicated by $E_y = E\sin\alpha$; because α is very small, if $\sin\alpha = tg\alpha = \frac{\omega}{C}$, $E_y = E\frac{u}{c}$ can be obtained; the output energy of E_y is indicated by $W_1 = \frac{\varepsilon_0 E^2 u^2}{2C^2}$. In the X direction, since the line E is moving at velocity u in the Y direction, the motion of electric field will inevitably be contracted; E will inevitably be increased; the magnetic field energy generated by an increase in E is $W_2 = \frac{\varepsilon_0 E^2 u^2}{2C^2}$ (see Formula 22). Obviously, $W_1 = W_2$, i.e. the electric field energy propagated by the electric wave, should be identically equal to the magnetic field energy. Because E_y has the same phase with u, and $B = \varepsilon_0\mu_0 u$E is also in phase with u. Therefore, the electric wave signal propagated by the electric wave is always in phase with the magnetic wave signal. To sum up, the electric wave is the process in which the variable motion condition of the electron is propagated at the velocity of light in its electric field. The twisting and contraction of the electric field may be caused by this propagation. The electric field energy of the electric wave is propagated by the twisted electric field, while the magnetic field energy of the electric wave is propagated by the contracted electric field. The electric field energy is identically equal to the magnetic field energy. The electric field signal of the electric wave is always in phase with the magnetic field signal. The electric wave is the wave motion propagation of the line of electric force, neither the magnetic field generated by the varying electric field, nor the electric field generated by the varying magnetic field.

It should be noted that, in order to explain the principle simply and clearly, the above plane wave is analyzed as a special case. However, the actual electric wave is not a plane wave, but for the non-planar wave, the characteristics of the electric wave can still be explained by the variation of the line of electric force. It is just that the amplitude of the line of electric force expressing the electric wave condition is not constant but gradually decreasing.

5. Derivation and Analysis of the Law of Electromagnetic Induction

5.1. Electromagnetic Wave and Electromagnetic Induction Law

As shown in Figure 9 (i.e. the simplified diagram of Figure 7), only the two lines E have been drawn;

moreover, the distance l shall be changed as the micro distance Δx, the law of motion of all electric field points at P along the direction of y coordinate shall be: $y_1 = f(t)$; the law of motion of all electric field points at l behind Point P along the direction of y coordinate shall be: $y = f(t - l/c)$; therefore, the law of motion of all electric field points at the micro distance Δx P' behind Point P along the direction of y coordinate shall be: $y_2 = f(t - \Delta x/c)$. The Formula (17) shows that, the component of E in the direction of y coordinate shall be: $E_y = -E_o tg\alpha Y_0$.

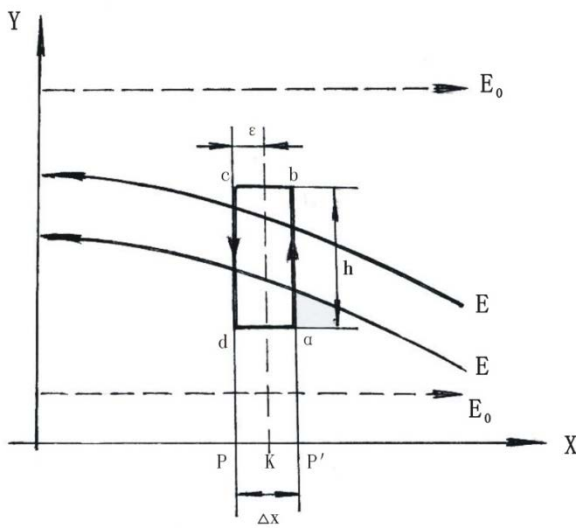

Figure 9. Potential on the closed loop generated by distortion of power line

It is indicated in the Formula 4.1 that, since $cos\,\alpha$ is a negative value ($\alpha > \pi/2$), so tgα shall also be a negative value. If dx is taken as the normal increments, then: $tg\alpha = -\dfrac{dy}{dx} = -\dfrac{df(t)}{dx}$.

After this formula is substituted into the Formula (17), the following formula can be obtained:

$$E_{y_1} = E_o \frac{df(t)}{dx} Y_0 \tag{25}$$

and

$$E_{y_1} = E_o \frac{df(t)}{dx} Y_0. \tag{26}$$

Obviously, E_{y_1} and E_{y_2} are the positive values. The Formula (25) & (26) can be written as the scalar formula below:

$$E_{y_1} = E_o \frac{df(t)}{dx} \text{ and } E_{y_2} = E_o \frac{df(t - \Delta x/c)}{dx}.$$

The potential on the loop abcd along the right-handed helical direction shall be shown in Figure 9 (analysis diagram):

$$\oint Edl = \int_a^b E_{y2} dy + \int_b^c (E_x - E_0) dx + \int_c^d -E_{y1} dy + \int_a^d (-E_x + E_0) dx.$$

Obviously, the above-mentioned item 4 and item 2 shall be equal in size of the integral, in which one positive and one negative can be offset each other, so that:

$$\oint Edl = \int_a^b E_{y2} dy - \int_c^d E_{y1} dy.$$

Because of the same E_{y2} on the line ab and the same E_{y1} on the line cd, h represents the length of ab and cd, so that the above formula can be converted into:

$$\oint Edl = E_{y2} h - E_{y1} h.$$

After the E_{y1} and E_{y2} in Formula (25) and (26) are substituted into the above formula, the following formula can be obtained:

$$\begin{aligned} \oint Edl &= E_o h \frac{d}{dx} f(t - \Delta x/c) - E_o h \frac{d}{dx} f(t) \\ &= -E_o h \frac{d}{dx} \left[f(t) - f(t - \Delta x/c) \right]. \end{aligned} \tag{27}$$

According to the Lagrangean mean value theorem, the following formula can be obtained:

$$\begin{aligned} f(t) - f(t - \Delta x/c) &= \left[t - \left(t - \frac{\Delta x}{c} \right) \right] \frac{d}{dt} f\left(t - \frac{\varepsilon}{c} \right) \\ &= \frac{\Delta x}{c} \frac{d}{dt} f\left(t - \frac{\varepsilon}{c} \right). \end{aligned}$$

In the above formula, ε represents the micro distance behind P ($\varepsilon < \Delta x$, as shown in Figure 9, at Point K). Since $df\left(t - \dfrac{\varepsilon}{c}\right)/dt$ indicates the velocity of E along the direction of y coordinate at K [Formula (14)], supposing that u represents this velocity, then the above formula can be converted into:

$$f(t) - f(t - \Delta x/c) = \frac{\Delta x}{c} u.$$

After the above formula is substituted into the Formula (27), the following formula can be obtained:

$$\oint Edl = -E_o h \frac{d}{dx} \left(\frac{\Delta x}{c} u \right) = -E_o \frac{h \Delta x}{c} \frac{du}{dx}.$$

Since $\dfrac{du}{dx} = \dfrac{du}{dt} \cdot \dfrac{dt}{dx}$.

Also, since $dx/dt = c$ and $h\Delta x$ represents the area surrounded by the loop abcd (expressed in S), then:

$$\oint Edl = -\frac{E_o S}{c^2} \frac{du}{dt} = -\frac{d}{dt} S \cdot \frac{E_o u}{c^2}.$$

According to the Formula (21), when u is perpendicular to E_o, since $B = E_o u/c^2$, the above formula can be converted into:

$$\oint Edl = -\frac{d}{dt} B \cdot S.$$

Since B.S is the magnetic flux φ surrounded by the loop abcd (Loop C), so the above formula can be written as:

$$\oint Edl = -\frac{d}{dt}\varphi. \tag{28}$$

Obviously, the Formula (28) is an expression for the law of electromagnetic induction.

5.2. Analysis of the Law of Electromagnetic Induction

A current I long rectangular coil is shown in Figure 10 (a). The left or right side of coil may be regarded as a current board. If it is equipped with n pieces of guide lines per unit length, this current board equivalently has the surface current (surface current density: nI). For simple analysis of problems, we may take the two surface plates A & B (height h) between two pieces of current boards for analysis. As shown in Figure 10 (b), A and B can represent the two pieces of current boards. The direction of motion of negative electrons of current Boards A & B shall be opposite to I. As can be seen, the current Boards A & B shall be similar to the "infinite" surface plates (as shown in Figure 7). When there are any changes in current size of coil, the negative electrons on current Boards A & B will be in variable motion. Thus, based on the above analysis, the current Boards A & B will launch the electromagnetic waves towards the left and right, respectively. According to the analytical derivation (Section 5.1), the electromagnetic waves launched by the current Boards A & B towards the left and right shall be consistent with the results of Formula (28).

We can analyze any changes in size of E_y propagated by A & B towards the left and right. According to the Formula (17) and (19), the scalar formula can be derived below:

$$E_y = E_o \frac{dy}{dx} = E_o \frac{u}{c}. \tag{29}$$

Obviously,

$$\frac{d}{dt}E_y = \frac{E_o}{c}\cdot\frac{du}{dt} = \frac{E_o}{c}a. \tag{30}$$

In the Formula (48),$a$represents the accelerated velocity of negative electron in variable motion. That is to say, any changes in size of E_y shall depend on the accelerated velocity of negative electron in variable motion.

We can analyze the electric field near the coil, e.g. the electric field within 3m from the coil. For the electromagnetic wave propagated at velocity of light, the time required for propagating the electromagnetic wave to 3m from the coil shall be less than 10^{-8} seconds or so. Within such a short period of time, it can be considered that there is the same magnitude of motion acceleration a of electric field near the current Boards A & B (a is unchanged within the time dt), namely,$a$is unchanged. If a is unchanged, $E_y$will be certainly increased or decreased in the proportion of$a$along the direction of$x$coordinate. If$a$is set as a positive value, E_y will be increased in the fixed proportion of$a$after moving to the current Board A, so that we can draw the size height line ofE_y on the left and right of current Board A (see the two straight lines on the top of Figure 10 (b)). Since the direction of motion of negative electron on the current Board B is opposite to the direction of motion of negative electron on the current Board A, so the size height line of E_y on the current Board B is opposite to the size height line of E_y on the current Board A (as shown in the Figure). The combination of$E_y$inside and outside the current Boards A & B shall refer to the combination of height lines of E_y on the current Boards A & B. The distribution diagram of combined$E_y$shall be shown in Figure 10(b). It's easy to see from the distribution diagram that, inside the current Boards A & B (coil), the potential on loop abcd shall be proportional to the width$b_1$of loop, which is proportional to the area of loop or the magnetic flux surrounded by the loop. However, outside the current Boards A & B (coil), the potential on loop a′b′c′d′ shall be unrelated to the width$b_2$of loop, which is irrelevant to the area of loop; the potential on loop a′b′c′d′ shall be equivalent to an electric potential produced when the width of loop is the same as the width b of coil; that is to say, the potential on loop a′b′c′d′ shall be only proportional to the magnetic flux in the coil. This explains why there is no any induced electric field existing in the magnetic field space outside the transformer.

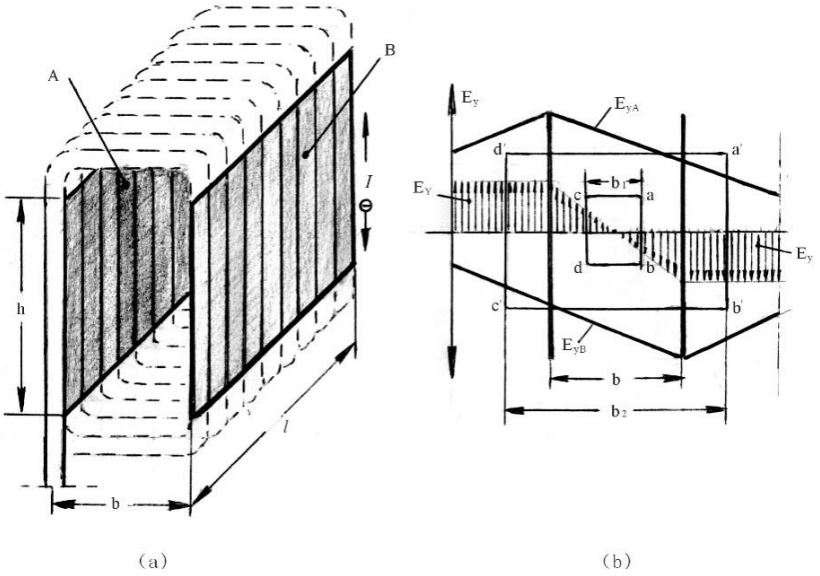

Figure 10. Distribution diagram of electric fields inside and outside the coil in case of current changes

By the above analysis of electromagnetic induction, the specific physical process of electromagnetic induction is clarified. This process shows that, some common electromagnetic induction phenomena in practice are essentially a transmission and reception process of electric wave.

6. Derivation of Displacement Current and Ampere Circuit Law

6.1. Derivation of Displacement Current Law

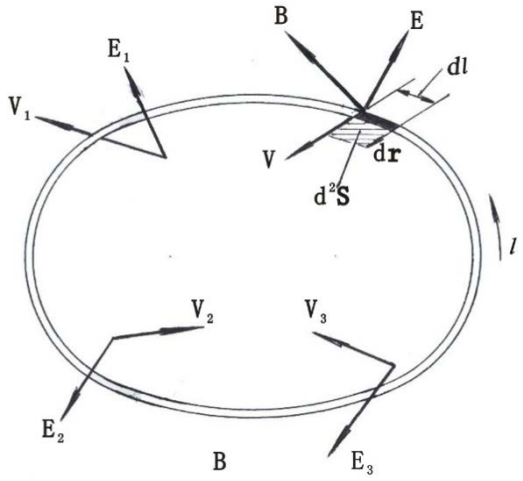

Figure 11. $d\varphi_D/dt$generated by the moving electric field when passing through Loop$l$

As shown in Figure 11, $l$represents any closed loop; with the winding direction: of right-handed helical direction (counterclockwise direction). It can be assumed that there are a lot of electric fields with different sizes and directions as formed in electron motion around the loop, E_1V_1,E_2V_2,E_3V_3…… We can analyze the motion of electric field atdlsegment (with the same direction as$l$) in terms of graphical representation.

The upward direction of electric field is defined as the positive$E$. The positive$E$passing through$dl$from the right end to the left end is called the positive pass-through, because this pass-through will increase the quantity of positive electric field of loop$l$. Similarly, the-E passing through dl from the left end to the right end is also called the positive pass-through, because this pass-through will reduce the quantity of positive electric field of loop$l$. In contrast with the above two cases, it shall be called the negative pass-through.

As shown in Figure 11, the moving$E$passes throughdlat velocity$V$within the timedt, and has moved forward to the distance dr. dl and dr (r and V are in the same direction) will form an elementary area$dl \times dr$for the length of side, respectively. Since$dl$and$dr$are both infinitesimal, so the product shall be the second-order infinitesimal, in which the elementary area is expressed by $d^2S = dl \times dr$. According to the Formula (1), E shall be in motion at$V$, to generate $B = \mu_o\varepsilon_o V \times E$, which can also be written as$H = B/\mu_0 = \varepsilon_o V \times E = V \times D$. The magnetic potential generated by H on dl shall be $H \cdot dl = (V \times D) \cdot dl$. According to the vector formula, $(V \times D) \cdot dl = (dl \times V) \cdot D$. Since$V = dr/dt$, this formula can be written as:

$$H \cdot dl = \left(dl \times \frac{dr}{dt}\right) \cdot D = \frac{1}{dt}(dl \times dr) \cdot D = \frac{1}{dt} d^2S \cdot D.$$

In the above formula, $d^2S \cdot D$ represents the electric displacement flux of **D** in an elementary area d^2S , expressed in $d^2\varphi_D$. So, the above formula can be transformed into $H \cdot dl = d^2\varphi_D/dt$. As a result, the following formula can be obtained:

$$\oint H \cdot al = \int_s d^2\varphi_D/dt = d\varphi_D/dt \qquad (31)$$

Obviously, in the Formula (31), $d^2\varphi_D/dt$represents the displacement current.

6.2. Derivation of Ampere Circuit Law

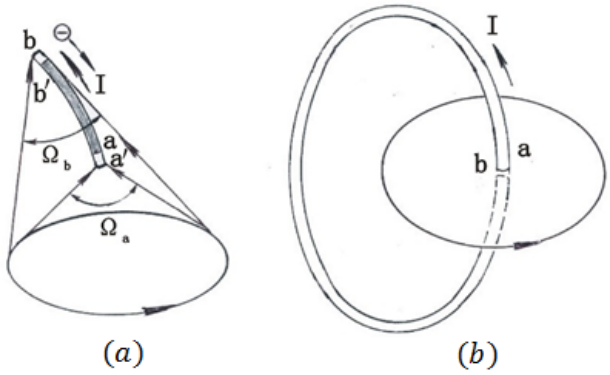

Figure 12. Proof of the Ampere Circuit Law

ab represents a section of current wire (as shown in Figure 12 (a)); the direction of current I: From bottom to top; the actual direction of motion of free electron: From top to bottom; the winding direction of loop l: Right-handed helical direction of I. Within the timedt, the negative electron beam will move from ba to $b'a'$. ba' represents the overlap between the two negative electron beams ba and $b'a'$ (black thick line in Figure 12a). Clearly, within the time dt, there is the same electric displacement flux of loop$l$ generated by$b'a$the overlapped negative electron beam which is unrelated to any changes in the electric displacement flux in the loop l. Therefore, $b'a'$ is bb' less than ba, but aa' more than ba, resulting in any changes in the electric displacement flux of loop l; according to the law of conservation of matter, bb' and aa' shall be of the same electric quantity, set as $-dQ$. Clearly, within the time dt , the negative electron beam ba is transformed into the negative electron beam $b'a'$. For any changes in the loop l , $-dQ$ of bb' is transformed into $-dQ$ of aa'. When deriving the relationship between the Gauss theorem and the Coulomb's law in physics, it is pointed out that, the electric displacement flux $d\varphi_D$ and dQ generated by dQ in a certain area shall be proportional to the solid angle Ω subtended by such an area; relationship: $d\varphi_D = \Omega dQ/4\pi$ (the solid angle of entire closed surface shall be: 4π). The solid angle of$-dQ$of aa' subtended by l: Ω_a; the solid angle of $-dQ$ of bb' subtended by l : Ω_b ; the upward direction of electric displacement generated by $-dQ$ of aa' and bb': Positive value. Thus, within the timedt, any changes in the total electric displacement flux of loop$l$ shall be as follows:

$$d\varphi_D = d\varphi_{aa'} - d\varphi_{bb'} = \frac{dQ}{4\pi}(\Omega_a - \Omega_b).$$

The above formula can be transformed into:

$$\frac{d\varphi_D}{dt} = \frac{dQ}{dt}\frac{(\Omega_a - \Omega_b)}{4\pi} = I\left(\frac{\Omega_a - \Omega_b}{4\pi}\right). \quad (32)$$

The magnetic potential of loop l can be calculated according to the Formula (32):

$$\oint H \cdot al = \frac{d\varphi_D}{dt} = \frac{(\Omega_a - \Omega_b)}{4\pi} I. \quad (33)$$

As shown in Figure 12 (b), the closed lead of Current I can pass through l. We can treat this closed lead as Point a on the surface consisting of loop l to Point b under the surface. Then, in accordance with the analysis method in the Formula (33), it can be considered that, $\Omega_a = 2\pi$, $\Omega_b = -2\pi$. Therefore, the magnetic potential on loop l generated by the closed lead (as shown in Figure 12 (b)) can be calculated according to the Formula (33):

$$\oint H \cdot al = \frac{(\Omega_a - \Omega_b)}{4\pi} I = \frac{2\pi - (-2\pi)}{4\pi} I = I. \quad (34)$$

Obviously, the Formula (34) shall be considered as Ampere's circuital law. According to the Formula (33) & (34), it can be deduced that, taking into account all the currents, the following formula can be obtained:

$$\oint H \cdot al = I + d\varphi_o / dt.$$

This is the law of total current,

It can be seen from the derivation of the above Ampere circuit law that, the Ampere circuit law is essentially the generalization or extension of the displacement current law. It can be seen from the derivation of the displacement current that, the displacement current is essentially that the magnetic field is an electric field being in motion.

7. The Velocity of Light is the Best Propagation Velocity of Electric Wave

As explained above, the electric wave is propagated at the velocity of light. The known velocity of propagation of light C is about 300,000km/s (kilometers per second). What will happen if the velocity of propagation of light is faster or slower?

Obviously, the greater C, the faster the velocity of propagation of electric wave signal and the better the astronomical observation effect. However, under the condition that the transmission power of the electric wave source is constant, that is, under the condition that the maximum velocity u of the electron is constant in the oscillating current of the electric wave source, it can be known from the formula (29) that, the initial signal intensity $E_y = E_0 \frac{u}{C}$ emitted by the electric wave source, that is, the initial signal strength E_y is inversely proportional to the velocity of light C, i.e. the larger C, the smaller the signal strength E_y, the worse the emission efficiency of the electric wave source. Moreover, it can be known from the formula (2) $B = V \times \frac{E^2}{C}$ that, the magnetic field effect is inversely proportional to the square of the velocity of light C, that is, as C increases rapidly, B will decrease rapidly, the volume of our electric motor, generator, magnetic equipment or other devices will increase rapidly, and the efficiency will decrease. Therefore, the actual velocity of light should not be greater any more. So, C is smaller or not? It can be said that this practice is not good, because a decrease in C will result in the following situations, in addition to slow signal reception: Since the magnetic effect is inversely proportional to C^2, a decrease in C will inevitably cause the electromagnetic radiation and the electromagnetic interference to increase rapidly. At present, the electromagnetic radiation and the electromagnetic interference cannot be ignored. All efforts have been made to prevent any electromagnetic radiation and interference of various types of electrical appliances. Any electromagnetic interference and radiation can be never allowed to increase rapidly. That is to say, the actual velocity of light is not expected to be slower. It can thus be seen that, the velocity of light should be neither greater nor less than about 300,000km/s. This means that, the actual velocity of light is the most favorable velocity of light for human beings. It can be argued that the actual velocity of light is another precious gift which the God has given to mankind!

8. Conclusions

By studying the electromagnetics, it can be seen that all the laws of electromagnetics are derived from a summary of some surface phenomena. There is no scientific explanation of the underlying causes of such laws. It is inevitable that errors will occur if the problem is analyzed according to the law of unknown cause. For example, when analyzing the rotating magnetic field of a magnet, there will be the velocity of magnetic field beyond a certain distance which can be greater than the velocity of light; when analyzing the interaction force between the current-carrying coil and the electric charge in motion, there will be the absurd analysis results that the acting force and the counter-acting force can be in the same direction. It should be considered that the source of the law of electromagnetics lacks the scientific explanation. The fundamental cause is that there is no scientific understanding of the nature of magnetism. Therefore, for the development of electromagnetics, it is very necessary to explore and understand the scientific nature of magnetism in depth.

The magnetic field generated by current is the basic viewpoint of electromagnetics. By analyzing the most basic magnetic field of moving electrified body, it can be found that the different observers have obtained the completely different results of judgment on the magnetic field generated by the moving electrified body. It indicates that there is an essential difference between the magnetic field and the real substance. That is to say, the magnetic field cannot be a real substance. In order to make the definition of the magnetic field conform to the objective

reality, a new definition of the magnetic field as the electric field in motion is put forward, and the basic formula (1) $B = \varepsilon_0 \mu_0 V \times E_0$ for expressing the magnetic induction intensity is determined by deriving the Biot-Shaval's law. When analyzing the interaction force between the two electrified bodies in relative motion, in the conclusion that the length of the substance is shortened in the direction of motion according to the special theory of relativity, it is deduced that the real substance electric field will inevitably contracted in the direction of motion, so that the electric field strength and the electric field force will increase, thus establishing the basic formula (3) $E' = \frac{E}{\sqrt{1-\frac{V^2}{C^2}}}$. From this formula, it is deduced and proved that the kinetic energy of the moving electric field in motion is the magnetic field energy. From the electric field in motion, not only can the magnitude of the magnetic field be expressed, but also can the magnetic force generated by the contraction of the electric field be measured. Our final definition of a magnetic field is that the magnetic field is an electric field that contracts in motion. Formula (1) and Formula (3) are the basic formulas for reflecting this point of view. The magnitude of the magnetic field can be calculated by Formula (1), while the force generated by the magnetic field can be calculated by Formula (3). The interaction force between the parallel current-carrying wires is scientifically and reasonably interpreted by Formula (3). Also, by Formulas (3) and (1), the Lorentz force is proved by deduction, and corrected to $F_V = \frac{F}{\sqrt{1-\frac{V^2}{C^2}}}$. The phenomenon of a decrease in the deflection distance of the charged particle in high-velocity motion in the magnetic field is correctly interpreted by F_V and the comprehensive Lorentz transformation. It is proved that the contraction of the electric field in the direction of motion is the true scientific truth. The phenomenon of heteropolar attraction and homopolar repulsion between the permanent magnets can be well interpreted according to the principle of contraction of the electric field in the direction of motion. Most importantly, it is proved by experiments that there is not only a negative electrostatic field but also a positive electrostatic field around the permanent magnet. The results of this experiment cannot be explained by electromagnetics, but can be interpreted scientifically and reasonably according to the principle of contraction of the electric field in the direction of motion. Since all the magnetic phenomena can be correctly interpreted according to the principle of contraction of the electric field in the direction of motion, it can be concluded that the contraction of the electric field in the direction of motion is the source of magnetism. The contraction of the electric field in the direction of motion is derived from the special theory of relativity, while the special theory of relativity is derived from the principle of constancy of light velocity, so it can be determined that the principle of constancy of light velocity is the source of magnetism. Magnetism is the foundation of the modernization of human science and technology modernization. It will inevitably be concluded that the principle of constancy of light velocity is the most precious gift which the God has given to mankind.

The motion with variable velocity of the electric field is analyzed. It is pointed out that the generation of electric wave is essentially resulted from the distortion and contraction of the electric field caused by the propagation of the motion with variable velocity of the electron of the wave source at the velocity of light in its electric field. The electric wave signal is generated and the electric field energy is output by the distortion of the electric field, while the magnetic wave signal is generated and the magnetic field energy is output by the contraction of the electric field. The electric field energy is identically equal to the magnetic field energy. The electric field signal and the magnetic field signal are always in the same phase. The law of electromagnetic induction is derived from the distortion of the electric field. It is proved by analytical electromagnetic induction that, the common electromagnetic induction phenomenon is the propagation and reception effect of the electric wave. It is proved by deduction that the Ampere circuit law is derived from the displacement current, and that the displacement current is derived from the electric field, i.e. the magnetic field in motion. By analyzing the propagation of electric wave, it is pointed out that, if the propagation velocity of electric wave is greater than the velocity of light, the propagation effect of electric wave will be rapidly weakened, the volume of the magnetic device will be rapidly increased, and the effect will be decreased. If the propagation velocity of electric wave is less than the velocity of light, the electromagnetic interference and radiation will be increased rapidly. Therefore, it is firmly believed that the actual velocity of light of about 300,000km/s is the best propagation velocity of electric wave for mankind. It is considered that the actual velocity of light is another precious gift which the God has given to mankind.

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