

This Is not Sufficient to Establish Scientific Truth

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Abstract: Empirical evidence and logical evidence demonstrate that most physical experiment results in electromagnetism, electrodynamics as long as in Maxwell's equations are only sufficient to verify the validity of the physical experiments themselves, but not sufficient to establish scientific truths. That is, the following fundamental laws and fundamental theories lack sufficient verification. This is why they fail to capture the true electromagnetic nature of the world and do not hold true. These fundamental laws and fundamental theories are: Oersted's law of electromagnetism which states that a current-carrying conductor generates a circular magnetic field surrounding the conductor, Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field, Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force, Lorentz force law which states that a moving charge experiences a force in a magnetic field, Biot-Savart law which provides a method to calculate the magnetic field at a point in space generated by a steady electric field, Ampère's circuital law, Ampère-Maxwell's law, Maxwell's conclusion that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, Faraday's conclusion that an open coil with the change of magnetic flux in it produces an electromotive force, and Maxwell's conclusion that a changing magnetic field forms a changing electric field in an empty space, that is, a vortex electric field in an empty space. In addition, this study also clarifies that: If a physical law X (or natural science theory X) is extracted from a physical experiment A, the reproducibility of the physical experiment A is only sufficient to verify the validity of the physical experiment A itself, but not sufficient to verify the validity of the physical law X, and at least one more physical experiment B should be designed and conducted to verify the validity of the physical law X. The physical experiment B must fully meet the requirements of the physical law X, but the physical experiment B must be completely different in terms of experimental composition from the physical experiment A. If the results of the physical experiment B are still consistent with the explanation of the physical law X, then the physical law X can be considered to be scientific truth. Otherwise, the physical law X is not sufficient to be scientific truth. If the physical experiment B cannot be found, then the physical law X can be considered to be temporarily true, but if the physical experiment B is found one day, it should still be verified as such.

Keywords: Physics experiments (empirical experiments); Logical experiments; The root cause for the falsification of fundamental laws and fundamental theories of electromagnetism; The root cause for the falsification of Maxwell's equations; The physical experiment to verify the validity of physical experiments; The physical experiment to verify the validity of physical laws and natural science theories.

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1. Introduction

Oersted's law of electromagnetism^[1] which states that a current-carrying conductor

generates a circular magnetic field surrounding the conductor, Ampère's force law^[2] which states that a current-carrying conductor experiences a force in a magnetic field, Faraday's law of motional electromotive force^[1] which states that a conductor cutting through magnetic field lines generates an electromotive force, Lorentz force law^[2] which states that a moving charge experiences a force in a magnetic field, Biot-Savart law^[3] which provides a method to calculate the magnetic field at a point in space generated by a steady electric field, Ampère's circuital law which states that the line integral of the magnetic flux density around a closed loop is equal to the product of the permeability of the medium multiplied by the current passing through the closed loop, Ampère-Maxwell's law^[4] which states that the line integral of the magnetic flux density around a closed loop is proportional to the sum of the conduction current and displacement current passing through the closed loop, Maxwell's conclusion that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, Faraday's conclusion that an open coil with the change of magnetic flux in it produces an electromotive force, Maxwell's conclusion^[9] that a changing magnetic field forms a changing electric field in an empty space, that is, a vortex electric field in an empty space have made an immense contribution to human scientific and technological civilization.

However, all these fundamental laws and fundamental theories are found to fail to capture the true electromagnetic nature of the world and do not hold true.

This study aims to dig out the root cause which deprives the validity of these fundamental laws and fundamental theories.

2. Concerning the insufficient verification of Oersted's law of electromagnetism which states that a current-carrying conductor generates a circular magnetic field surrounding the conductor

In a physical experiment as shown in Figure 1, when Oersted brought a magnetic needle close to the conductor of a current-carrying closed loop, he found that the magnetic needle was deflected, then, Oersted concluded that a current-carrying conductor itself generated a magnetic field, and extracted Oersted's law of electromagnetism which states that a current-carrying conductor generates a circular magnetic field surrounding the conductor. In this physical experiment, Oersted achieves a revolutionary discovery that magnetic fields can be generated by electric currents. However, there are two possible reasons here for the generation of the circular magnetic field surrounding the conductor: One is that the current-carrying conductor itself generates a circular magnetic field surrounding the conductor, as stated by Oersted's law of electromagnetism; The other one is that the current-carrying closed loop as a whole generates a magnetic field, since this magnetic field has to extend to the other side of the closed loop to form a closed magnetic loop, so it has to surround the edge of the closed loop, and then forms an illusion that the magnetic field is generated by the current-carrying conductor itself.

Logically, in a process of scientific experiments, the observed phenomena cannot be directly regarded as the nature, let alone the so-called nature obtained in this way can be extracted into physical laws or natural science theories. Therefore, after obtaining this revolutionary discovery, it is reasonable for Oersted to design and conduct another experiment to determine whether the magnetic field is generated by the current-carrying conductor itself or by the current-carrying closed loop as a whole. That is, to design and

conduct at least one physical experiment which must fully meet the requirements of his law here, but completely different in terms of experimental composition from the physical experiment he just conducted for this issue to see if the law works or not.

However, Oersted did not make such a question, instead, he directly took this phenomenon as the true electromagnetic nature of the world and extracted Oersted's law of electromagnetism with it. In fact, regardless of whether Oersted's law of electromagnetism itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Oersted's law of electromagnetism, there is no effective further confirmation of whether the observed phenomenon is the nature or not was conducted, instead the observed phenomenon is directly determined to be the nature and a physical law is extracted with it. In a word, no matter whether Oersted's law of electromagnetism itself is true or not, its construction procedure is logically disordered.

Therefore, what Oersted did here on this issue is not sufficient to establish scientific truth.

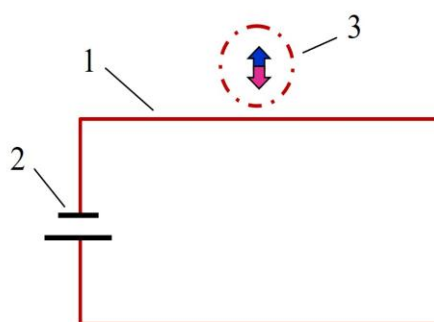


Figure 1. A schematic illustration of the device that Oersted used to obtain Oersted's law of electromagnetism which states that a current-carrying conductor generates a circular magnetic field surrounding the conductor. 1. Current carrying closed loop, 2. Battery, 3. Magnetic needle.

In the following, whether the magnetic field is generated by the current-carrying conductor itself as described in Oersted's law of electromagnetism or generated by the current-carrying closed loop as a whole consisting of the current-carrying conductor is investigated.

If the magnetic field is not generated by the current-carrying closed loop as a whole, but generated by the current-carrying conductor itself as described in Oersted's law of electromagnetism, then the Voltmeter 5 shown in Figure 2 must detect a significant current. This is because that in the device shown in Figure 2, the rotation direction of the magnetic field in the transformer core and the rotation direction of the magnetic field generated by the current-carrying conductor segment corresponding to the measurement loop (assuming that a current-carrying conductor segment generates magnetic fields) are opposite. Therefore, the magnetic field generated by the current-carrying conductor segment corresponding to the measurement loop cannot form closed magnetic loops through the transformer core, but can only pass through the measurement loop to form closed magnetic loops. Therefore, if the current-carrying conductor segment corresponding to the measurement loop generates a magnetic field, the measurement loop must generate a significant induced electromotive force, and the Voltmeter 5 must detect a significant voltage.

In order to test whether there is a voltage at Voltmeter 5 shown in Figure 2, an experimental device as shown in Figure 2 is designed and fabricated. This experimental device is an 1kW, 220V, 50 Hz transformer which is 48mm in the cross-sectional diameter of its

core and is 130mm in the center circle diameter of the core. The measured voltage of the secondary coil of this transformer is 0.717V per turn, and the total voltage is 26.618V. As shown in Figure 2, the arc shaped conductor segment of a center angle of 120 degrees of the measurement coil which is a three-turn coil is set next to the secondary coil of the transformer. If Oersted's law of electromagnetism holds true, theoretically the electromotive force in the measurement loop should be around 0.717 volts. However, when this transformer primary coil is connected to a 220V, 50Hz power supply and the secondary coil load is set with two bulbs of 24V, 55W, that is, 110W in total, the actual measurement reading at the measurement loop's Voltmeter 5 (with a resolution of 1 millivolt) is 0.000 volts. This physical experiment results indicate that Oersted's law of electromagnetism fails to capture the true electromagnetic nature of the world and does not hold true, that is, magnetic fields are generated by a current-carrying closed loop as a whole, but not generated by a current-carrying conductor itself as described in Oersted's law of electromagnetism. That is, electric current itself does not generate magnetic fields, only a closed loop of electric current generates magnetic fields.

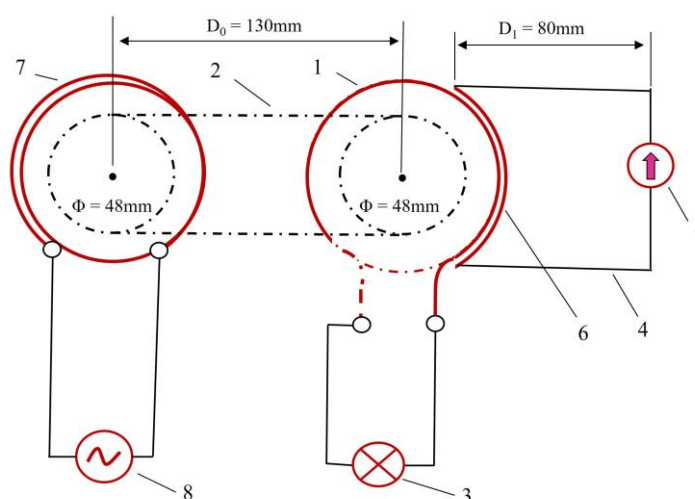


Figure 2. A schematic illustration of the device for the physical experiments to determine if magnetic fields are generated by a current-carrying closed loop as a whole or by current-carrying conductor segment itself. 1. Transformer secondary coil, 2. The transformer core of 1kW, 220V, 50 Hz, 3. Lamp of 24V, 110W in total, 4. Measurement loop for the measurement of the magnetic field generated by current-carrying conductor segment itself, 5. Voltmeter, 6. The measurement loop's arc shaped conductor segment, 7. Transformer primary coil, 8. AC power supply of 220V, 50Hz.

If the magnetic field is not generated by the current-carrying closed loop as a whole, but generated by the current-carrying conductor itself as described in Oersted's law of electromagnetism, then the Voltmeter 5 shown in Figure 3 must detect a significant current. This is because that in the device shown in Figure 3, the rotation direction of the magnetic field in the transformer core and the rotation direction of the magnetic field generated by a current-carrying conductor segment itself of the transformer secondary coil, which is the measurement loop's arc shaped conductor segment (assuming that a current-carrying conductor segment generates magnetic fields), are opposite. Therefore, the magnetic field generated by the current-carrying conductor segment itself of the transformer secondary coil, which is the measurement loop's arc shaped conductor segment, cannot form closed magnetic loops through the transformer core. Then, this magnetic field can only pass through the measurement loop to form closed magnetic loops. Therefore, if the current-carrying conductor segment itself of the transformer secondary coil, which is the measurement loop's arc shaped conductor segment, generates a magnetic field, the measurement loop must generate a significant induced electromotive force, and the Voltmeter 5

must detect a significant voltage.

In order to test whether there is a voltage at Voltmeter 5 shown in Figure 3, an experimental device as shown in Figure 3 is designed and fabricated. This experimental device is an 1kW, 220V, 50 Hz transformer which is 48mm in the cross-sectional diameter of its core and is 130mm in the center circle diameter of the core. The measured voltage of the secondary coil of this transformer is 0.717V per turn, and the total voltage is 26.618V. As shown in Figure 3, the arc shaped conductor segment of the measurement coil is the segment of a center angle of 120 degrees of one turn coil of the secondary coil of the transformer. If Oersted's law of electromagnetism holds true, theoretically the electromotive force in the measurement loop should be around $0.717/3=0.239$ volts. However, when this transformer primary coil is connected to a 220V, 50Hz power supply and the secondary coil load is set with two bulbs of 24V, 55W, that is, 110W in total, the actual measurement reading at the measurement loop's Voltmeter 5 (with a resolution of 1 millivolt) is 0.000 volts. This physical experiment results indicate that Oersted's law of electromagnetism fails to capture the true electromagnetic nature of the world and does not hold true, that is, magnetic fields are generated by a current-carrying closed loop as a whole, but not generated by a current-carrying conductor itself as described in Oersted's law of electromagnetism. That is, electric current itself does not generate magnetic fields, only a closed loop of electric current generates magnetic fields.

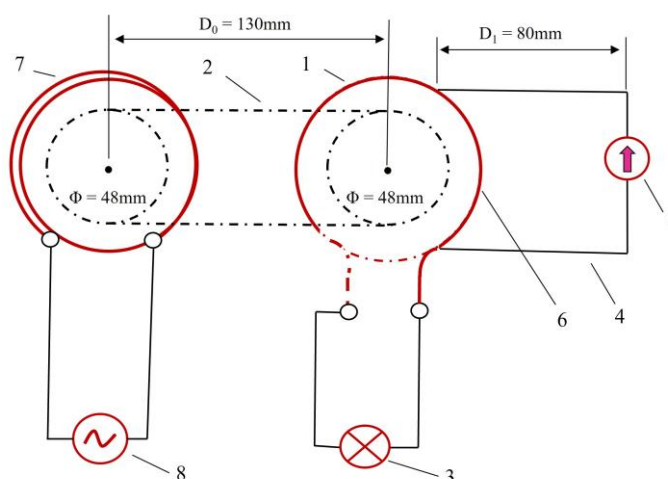


Figure 3. A schematic illustration of the device for the physical experiments to determine if magnetic fields are generated by a current-carrying closed loop as a whole or by current-carrying conductor segment itself. 1. Transformer secondary coil, 2. The transformer core of 1kW, 220V, 50 Hz, 3. Lamp of 24V, 110W in total, 4. Measurement loop for the measurement of the magnetic field generated by current-carrying conductor segment itself, 5. Voltmeter, 6. The measurement loop's arc shaped conductor segment which is a part of the transformer secondary coil, 7. Transformer primary coil, 8. AC power supply of 220V, 50Hz.

Not only that, according to a published paper^[5], other physical experiments have also proved that the Oersted's law of electromagnetism is not true; According to another published paper^[6], logical experiments have also proved that the Oersted's law of electromagnetism is not true. Not only that again, if magnetic field is not generated by a current-carrying closed loop as a whole, but generated by a current-carrying conductor itself as described in Oersted's law of electromagnetism, then all transformers and all other devices that rely on winding cores cannot work, because in that case, the rotational topology of the magnetic field through the core is contrary to the rotational topology of the magnetic field generated by the winding conductor itself, so there must be no magnetic fields in the core. This is clearly contrary to the facts and absolutely is absurd. Therefore, there

cannot possibly be any possibility for magnetic fields to be generated by a current-carrying conductor itself as described in Oersted's law of electromagnetism. That is, in the process of producing a magnetic field by a time-varying electric current (representing a time-varying electric field), the magnetic field is not generated by the current-carrying conductor itself, but by the current-carrying closed loop as a whole, and the smallest physical unit that is indispensable for generating a magnetic field is a closed loop of one turn as a whole, not the conductor itself of an open coil or a current-carrying conductor segment itself of the current-carrying closed loop which is generating a magnetic field.

Further, the content of Faraday's law of electromagnetic induction is that the electromotive force around a closed loop is equal to the negative of the time rate of change of the magnetic flux enclosed by the closed loop. This indicates that when the magnetic flux in the closed loop changes, the closed loop as a whole generates an electromotive force, and the process of generating this electromotive force must be the process of a change of current in the closed loop as a whole, because the current is directly proportional to the electromotive force. Because the process of generating a magnetic field from an electric current happens to be the reverse process of generating an electromotive force from a magnetic field, that is, it happens to be the reverse process of this Faraday's law of electromagnetic induction.

Therefore, the process of generating a magnetic field from an electric current must be: The closed loop as a whole with a change of an electromotive force in it generates a magnetic field, that is, the closed loop as a whole with a change of current in it generates a magnetic field, and the amount of magnetic flux generated in the closed loop (the change of magnetic flux) is directly proportional to the change of electromotive force in the closed loop, that is, it is directly proportional to the change of current in the closed loop.

Therefore, in the process of electromagnetic induction, the magnetic field is generated by the closed loop as a whole, not by the segment (it can be insulator) itself of the closed loop. This indicates that Oersted's law of electromagnetism fails to capture the true electromagnetic nature of the world and does not hold true, that is, magnetic fields are generated by a current-carrying closed loop as a whole, but not generated by a current-carrying conductor itself as described in Oersted's law of electromagnetism. That is, electric current itself does not generate magnetic fields, only a closed loop of electric current generates magnetic fields.

Furthermore, because Oersted's law of electromagnetism is built upon phenomenon rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for Oersted's law of electromagnetism to capture the true electromagnetic nature of the world and to hold true. That is, there cannot possibly be any possibility for a current-carrying conductor itself to generate electric field. In electromagnetic induction process, the magnetic field is generated by the current-carrying closed loop as a whole, not by the current-carrying conductor itself.

Since Oersted's law of electromagnetism is the foundation of Biot-Savart law, Ampère's circuital law^[8], Ampère-Maxwell's law^{[4] [9]}, therefore Biot-Savart law which provides a method to calculate the magnetic field at a point in space generated by a steady electric field, Ampère's circuital law which states that the line integral of the magnetic flux density around a closed loop is equal to the product of the permeability of the medium multiplied by the current passing through the closed loop, and Ampère-Maxwell's law which states that the line integral of the magnetic flux density around a closed loop is proportional to

the sum of the conduction current and displacement current passing through the closed loop, all these three laws lack sufficient verification, all fail to capture the true electromagnetic nature of the world and all do not hold true.

In summary, there cannot possibly be any possibility for Oersted's law of electromagnetism to capture the true electromagnetic nature of the world; there cannot possibly be any possibility for Biot-Savart law to capture the true electromagnetic nature of the world; there cannot possibly be any possibility for Ampère's circuital law to capture the true electromagnetic nature of the world; there cannot possibly be any possibility for Ampère-Maxwell's law to capture the true electromagnetic nature of the world. All these laws have no way to hold true.

In fact, because Biot and Savart mistakenly trust and believe that the false Oersted's law of electromagnetism which states that a current-carrying conductor generates a circular magnetic field surrounding the conductor holds true, then they extract Biot-Savart law with it. In fact, because Ampère mistakenly trusts and believes that the false Biot-Savart law holds true, then he extracts Ampère's circuital law with it. In fact, because Maxwell mistakenly trusts and believes that the false Ampère's circuital law holds true, then he formulates the equations with it, that is, the integral form equation of Ampère-Maxwell's law described below:

$$\oint_L B \cdot dl = \mu_0 I + \mu_0 \epsilon_0 \frac{d}{dt} \iint_S E \cdot ds$$

which fails to capture the true electromagnetic nature of the world and does not hold true, and the differential form equations of Ampère-Maxwell's law described below:

$$\nabla \times H = J_f + \frac{\partial D}{\partial t}$$

and

$$\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$$

both fail to capture the true electromagnetic nature of the world and does not hold true.

Although these two differential form equations can be obtained by applying Stokes' theorem to the integral form equation described above, however, since the integral form equation described above fails to capture the true electromagnetic nature of the world and does not hold true, consequently, these two differential form equations also fail to capture the true electromagnetic nature of the world and do not hold true from the perspective of applying Stokes' theorem, either.

However, this does not affect the greatness of Oersted, because the mere discovery that the magnetic field can be generated by an electric current is great enough, and in that era, the question of whether it was produced by the current-carrying conductor itself or by the current-carrying closed loop as a whole can be ignored, compared with the great discovery that the magnetic field can be generated by the current. Today, we can find that Oersted's law of electromagnetism is not true, and it can only be done by standing on the

shoulders of the great giant Oersted.

The closed loop here can be a closed loop consisting solely of conductors, a closed loop consisting solely of non-conductors, a closed loop consisting of a mixture of conductors and non-conductors, or a closed loop including displacement current and convection current. In a word, the closed loop here is a closed loop consisting solely of matters or a closed loop composed of matter and empty spaces (vacuum), collectively named as the closed loop of matters. Because as long as there is matter, the charge will at least deflect under the action of an electromotive force (representative of the electric field), and then form a closed loop effect to convert the electromotive force (electric field) into electric current in the closed loop, which in turn into a magnetic field. The current here refers to the total current, that is, it includes conduction current, displacement current and convection current.

3. Concerning the insufficient verification of Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field

In a physical experiment as illustrated in the lower part of Figure 4, it was observed that a current-carrying conductor of a current-carrying closed loop's experiences a force and moves when it is placed in a magnetic field. Based on this observation, Ampère extracted Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field, as illustrated in the upper part of Figure 4. However, in the physical experiment as illustrated in the lower part of Figure 4, the movement of the current-carrying conductor will inevitably cause a change in magnetic flux and/or in magnetic flux density within the closed loop consisting of the current-carrying conductor.

This indicates that in the process of making a current-carrying conductor to experience a force in a magnetic field, the magnetic flux and/or magnetic flux density within the closed loop consisting of the current-carrying conductor must be changed.

Therefore, there are two possible reasons here for the generation of the force on the current-carrying conductor: One is that the current-carrying conductor itself is forced by the magnetic field which it is in as stated by Ampère's force law; The other one is that the current-carrying conductor is forced by the change in magnetic flux and/or in magnetic flux density within the closed loop as a whole consisting of the current-carrying conductor.

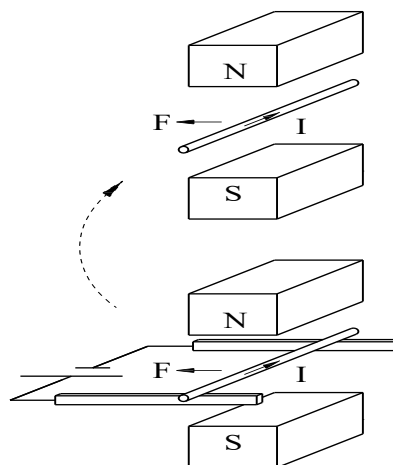


Figure 4: A schematic illustration of the construction processes of Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field.

Logically, in a process of scientific experiments, the observed phenomena cannot be directly regarded as the nature, let alone the so-called nature obtained in this way can be extracted into physical laws or natural science theories. Therefore, after obtaining this revolutionary discovery stated in the lower part of Figure 4, it is reasonable for Ampère to design and conduct another experiment to determine whether the force on the current-carrying conductor is generated by the current-carrying conductor itself in a magnetic field or by the change in magnetic flux and/or in magnetic flux density within the current-carrying closed loop consisting of the current-carrying conductor. That is, to design and conduct at least one physical experiment which must fully meet the requirements of his law here, but completely different in terms of experimental composition from the physical experiment he just conducted for this issue to see if the law works or not. However, Ampère did not make such a question, instead, he directly took this phenomenon as the true electromagnetic nature of the world and extracted Ampère's force law with it.

In fact, regardless of whether Ampère's force law itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Ampère's force law, there is no effective further confirmation of whether the observed phenomenon is the nature or not was conducted, instead the observed phenomenon is directly determined to be the nature and a physical law is extracted with it. In a word, no matter whether Ampère's force law itself is true or not, its construction procedure is logically disordered.

Therefore, what Ampère did here on this issue is not sufficient to establish scientific truth.

According to published papers^{[5][6]}, it is proved that the force on the current-carrying conductor is not due to the current-carrying conductor is forced by the magnetic field which it is in as stated by Ampère's force law, but due to the change in magnetic flux and/or in magnetic flux density within the closed loop as a whole consisting of the current-carrying conductor. In other words, Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field, as illustrated in the upper part of Figure 4, fails to capture the true electromagnetic nature of the world and does not hold true.

Furthermore, because Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field is built upon phenomenon rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for this Ampère's force law to capture the true electromagnetic nature of the world and to hold true. And there is no Ampère's force in the world, but there is electromagnetic fore in the world. The fore on a current-carrying conductor in a magnetic field is the electromagnetic fore which is self-balanced in the closed loop as a whole, that is the closed loop consisting of current-carrying conductor.

4. Concerning the insufficient verification of Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force

In a physical experiment as illustrated in the lower part of Figure 5, it was observed that when a closed loop's conductor moves and cuts through magnetic field lines, the closed loop generates electric current. Based on this observation, Faraday extracted the Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force, as illustrated in the upper part of Figure 5. However, in the physical experiment as illustrated in the lower part of Figure 5, the movement of the conductor cutting through magnetic field lines in generating the

motional electromotive force inevitably leads to a change in magnetic flux within the closed loop consisting of the conductor cutting through magnetic field lines. This indicates that in this process, the magnetic flux within the closed loop consisting of the conductor cutting through magnetic field lines must be changed. Therefore, there are two possible reasons here for the generation of the motional electromotive force: One is that the motional electromotive force is generated by a conductor cutting through magnetic field lines itself, as stated by Faraday's law of motional electromotive force; The other one is that the motional electromotive force is generated by the change in magnetic flux within the closed loop as a whole consisting of the conductor cutting through magnetic field lines.

Logically, in a process of scientific experiments, the observed phenomena cannot be directly regarded as the nature, let alone the so-called nature obtained in this way can be extracted into physical laws or natural science theories. Therefore, after obtaining this revolutionary discovery stated in the lower part of Figure 5, it is reasonable for Faraday to design and conduct another experiment to determine whether the motional electromotive force is generated by a conductor cutting through magnetic field lines itself, as stated by Faraday's law of motional electromotive force, or the motional electromotive force is generated by the change in magnetic flux within the closed loop as a whole consisting of the conductor cutting through magnetic field lines. That is, to design and conduct at least one physical experiment which must fully meet the requirements of his law here, but completely different in terms of experimental composition from the physical experiment he just conducted for this issue to see if the law works or not. However, Faraday did not make such a question, instead, he directly took this phenomenon as the true electromagnetic nature of the world and extracted Faraday's law of motional electromotive force with it.

In fact, regardless of whether Faraday's law of motional electromotive force itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Faraday's law of motional electromotive force, there is no effective further confirmation of whether the observed phenomenon is the nature or not was conducted, instead the observed phenomenon is directly determined to be the nature and a physical law is extracted with it. In a word, no matter whether Faraday's law of motional electromotive force itself is true or not, its construction procedure is logically disordered.

Therefore, what Faraday did here on this issue is not sufficient to establish scientific truth.

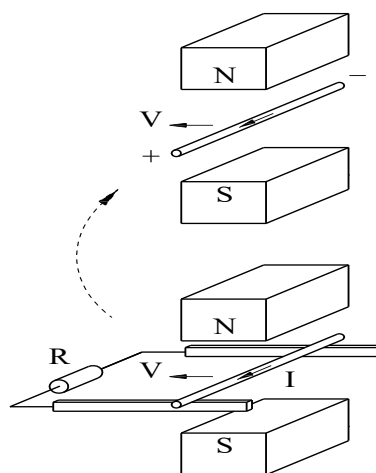


Figure 5: A schematic illustration of the construction processes of the Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force.

According to published papers^{[5] [6]}, it is proved that the motional electromotive force is not generated by a conductor cutting through magnetic field lines itself as stated by Faraday's law of motional electromotive force, but the motional electromotive force is generated by the change in magnetic flux within the closed loop as a whole consisting of the conductor cutting through magnetic field lines. In other words, Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force, as illustrated in the upper part of Figure 5, fails to capture the true electromagnetic nature of the world and does not hold true.

Furthermore, because Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force is built upon phenomenon rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for this Faraday's law of motional electromotive force to capture the true electromagnetic nature of the world and to hold true.

In fact, there is no difference between motional electromotive force and induced (transformer) electromotive force in the world, the two electromotive forces are exactly the same thing. The conductor cutting through magnetic field lines itself does not generate electromotive force^{[5] [6]}, so there is no motional electromotive force in the world. The electric field and the electromotive force generated by the change of magnetic flux in the closed loop are generated by the closed loop as a whole, not by its components, and its components do not generate an electric field or an electromotive force at all. The closed loop here is the closed loop of matters described above.

In one word, Faraday's law of electromagnetic induction^[7] which states that a closed loop with a change in magnetic flux inside it generates an electric current captures the true electromagnetic nature of the world and does hold true, however, Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force fails to capture the true electromagnetic nature of the world and does not hold true.

5. Concerning the insufficient verification of Lorentz force law which states that a moving charge experiences a force in a magnetic field

In a physical experiment as illustrated in the lower part of Figure 6, it was observed that a moving charge of a closed loop consisting of the beam (that is, the convection current) of the moving charge experiences a force and curves when the moving charge is placed in a magnetic field. Based on this observation, Lorentz extracted Lorentz force law which states that a moving charge experiences a force in a magnetic field, as illustrated in the upper part of Figure 6. The moving charge is often thought of as an isolated charge beam only, but in fact this charge beam is segment part of closed loops containing this charge beam, but it is often overlooked, because this closed loop includes non-conductors, gaps and displacement current. However, in the physical experiment illustrated in the lower part of Figure 6, the curving motion of the charge would inevitably cause a change in magnetic flux within the closed loop consisting of the charge beam. This indicates that in this process, the magnetic flux within the closed loop consisting of the charge beam must be changed. Therefore, there are two possible reasons here for the generation of the Lorentz force: One is that the Lorentz force is generated by a moving charge in a magnetic field itself, as stated by Lorentz force law; The other one is that the Lorentz force is generated by the change in magnetic flux within the closed loop as a whole consisting of the charge beam.

Logically, in a process of scientific experiments, the observed phenomena cannot be directly regarded as the nature, let alone the so-called nature obtained in this way can be extracted into physical laws or natural science theories. Therefore, after obtaining this revolutionary discovery stated in the lower part of Figure 6, it is reasonable for Lorentz to design and conduct another experiment to determine whether the Lorentz force is generated by a moving charge in a magnetic field itself as stated by Lorentz force law or the Lorentz force is generated by the change in magnetic flux within the closed loop as a whole consisting of the charge beam. That is, to design and conduct at least one physical experiment which must fully meet the requirements of his law here, but completely different in terms of experimental composition from the physical experiment he just conducted for this issue to see if the law works or not. However, Lorentz did not make such a question, instead, he directly took this phenomenon as the true electromagnetic nature of the world and extracted Lorentz force law with it. In fact, regardless of whether Lorentz force law itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Lorentz force law, there is no effective further confirmation of whether the observed phenomenon is the nature or not was conducted, instead the observed phenomenon is directly determined to be the nature and a physical law is extracted with it. In a word, no matter whether Lorentz force law itself is true or not, its construction procedure is logically disordered.

Therefore, what Lorentz did here on this issue is not sufficient to establish scientific truth.

According to published papers^{[5] [6]}, it is proved that the force on a moving charge in a magnetic field is generated by the change in magnetic flux within the closed loop as a whole consisting of the charge beam, but not by a moving charge in a magnetic field itself as stated by Lorentz force law. In other words, Lorentz force law which states that a moving charge experiences a force in a magnetic field, as illustrated in the upper part of Figure 6, fails to capture the true electromagnetic nature of the world and does not hold true, and there is no Lorentz force in the world, but there is electromagnetic fore in the world. The force on a moving charge in a magnetic field is the electromagnetic fore which is self-balanced in the closed loop as a whole, that is the closed loop consisting of the charge beam.

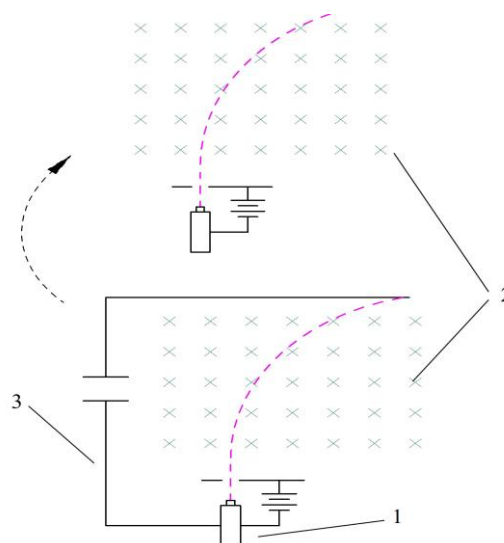


Figure 6. A schematic illustration of the construction processes of Lorentz force law which states that a moving charge experiences a force in a magnetic field. 1. Electron reflex gun, 2. Magnetic field lines, 3. A closed loop containing the displacement current.

Furthermore, because Lorentz force law which states that a moving charge experiences a force in a magnetic field is built upon phenomenon rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for this Lorentz force law to capture the true electromagnetic nature of the world and to hold true.

The closed loop here is the closed loop of matters described above.

6. Concerning the insufficient verification of Maxwell's conclusion that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop

Fundamentally, what Faraday's law of electromagnetic induction explains is that:

- (1) The process of generating an electromotive force (representing an electric field) by magnetic fields must meet two necessary conditions, both of them are indispensable: one is the existence of a closed loop, and the other is the change of magnetic flux in the closed loop;
- (2) The changing magnetic field (/the time-varying magnetic field) must cause the magnetic flux in the closed loop to change in order to generate an electric field and an electromotive force, otherwise, it cannot generate electric field or electromotive force;
- (3) The changing magnetic field here is with respect to a closed loop and must cause a change in magnetic flux inside the closed loop, but is not with respect to an empty space (vacuum);
- (4) Even if the magnetic field changes with respect to an empty space, if the magnetic field does not change with respect to the closed loop and cannot cause the change of magnetic flux in the closed loop, it still cannot generate an electric field, a vortex electric field, an electromotive force, or an electric current at all.

In other words, fundamentally, what Faraday's law of electromagnetic induction explains is that: (1) A closed loop is the necessary condition for electromagnetic induction; (2) A changing magnetic field itself does not generate an electric field, an electromotive force, or a vortex electric field in an empty space, since if a changing magnetic field itself can generate an electric field, an electromotive force, and a vortex electric field in an empty space, there will be no need for a closed loop.

However, if the changing magnetic field can cause matter to electrically close a loop including empty spaces (vacuum) to create an electric field and an electromotive force, then an electromagnetic induction can take place, in this case the closed loop includes displacement currents. However, this also indicates that a closed loop is the necessary condition for electromagnetic induction. Therefore, the electric field and the electromotive force generated by the change of magnetic flux in a closed loop are generated by the closed loop as a whole, not by its components, and its components do not generate an electric field or an electromotive force at all. The closed loop here is the closed loop of matters described above.

However, for some reason, Maxwell believes that if a closed loop generates electromotive force according to Faraday's law of electromagnetic induction, the segments of the closed

loop also generate electromotive force, and the electromotive force generated by the closed loop as a whole is equal to the integral of the electromotive force generated by the segments of the closed loop. This is why the physics community has always believed that when a closed loop with a change in magnetic flux inside it generates an electromotive force, each section of the closed loop generates some electromotive force, and the electromotive force of the whole closed loop is the integral of the electromotive force generated by each constituent parts of the closed loop.

In fact, whether the electromotive force (representing the electric field) generated by a closed loop with a change in magnetic flux inside it is generated by the closed loop as a whole, or is the accumulation of the electromotive force generated by the conductor segment of the closed loop is a major scientific question. In other words, whether the smallest indispensable physical unit that generates an electromotive force from a magnetic field is a closed loop of one turn as a whole, or is the conductor or material segment itself is major scientific question. It is called a major scientific problem because it explains a totally different electromagnetic nature of the world, by this difference.

If the electromotive force generated by a closed loop with a change in magnetic flux in it is not generated by the closed loop as a whole, but is generated by the conductor segment of the closed loop and is the accumulation of the electromotive force generated by the conductor segment of the closed loop, that is, if the smallest indispensable physical unit that generates an electromotive force by magnetic field is not the closed loop of one turn as a whole, but is the conductor segment of the closed loop, then, there must be voltage between the two points of each of these voltage-measurement point pairs C_1 and C_2 , C_2 and C_3 , C_3 and C_4 , and D_1 and D_2 , shown in Figure 7, with the exception for the resistive voltage drop, because it is outside the scope of this question.

As shown in Figure 7, the distance on coil between the two voltage-measurement points of each of the four voltage-measurement pairs C_1 and C_2 , C_2 and C_3 , C_3 and C_4 , and D_1 and D_2 is one-ninth of the length of the entire closed loop. Therefore, if Maxwell's conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, is true, then the voltage between the two voltage-measurement points of each voltage-measurement pair should be about one-ninth of 0.717V, that is, about 0.080V, because the measured voltage of this entire closed loop is 0.717V.

In order to determine whether there is any voltage between two voltage-measurement points of these voltage-measurement point pairs, the voltage across two voltage-measurement points of each pair were measured, and the result was that the voltage between the two points of every pair was 0.000V, with a Voltmeter (with a resolution of 1 millivolt) .

Not only that, there cannot possibly be any voltage between the two points of any of these voltage-measurement point pairs C_1 and C_2 , C_2 and C_3 , C_3 and C_4 , and D_1 and D_2 , shown in Figure 7. Because if there is voltage between the two points of any of these voltage-measurement point pairs, then there must be voltage between any two points on any AC transmission power lines, because any AC transmission power lines are part of a closed loop with a change in magnetic flux within it, with exception for the resistive voltage drop, since it is outside the scope of this question.

induction, the segments of the closed loop also generate electromotive force, and the electromotive force generated by the closed loop as a whole is equal to the integral of the electromotive force generated by the segments of the closed loop. After reaching this Maxwell's conclusion, Maxwell did not conduct any physical experiments to prove this conclusion.

In fact, humans have never logically correctly detected an electromotive force generated on a conductor segment of the closed loop producing an electromotive force under the action of a changing magnetic field, or with a change in magnetic flux within the closed loop. Maxwell's conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, seems impenetrable, but it is a fatal logical error. Because this conclusion essentially replaces the closed loop, which is the prerequisite for generating electromotive force, that is, the necessary condition of Faraday's law of electromagnetic induction for generating electromotive force, with a component of the closed loop. This essentially eliminates the prerequisite (necessary condition) for generating electromotive force. In fact, this Maxwell's conclusion violates Faraday's law of electromagnetic induction.

Because Maxwell's conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, is built upon an extrapolation with a broken chain of reasoning rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for Maxwell's conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, to capture the true electromagnetic nature of the world and to hold true.

Logically, in a process of scientific extrapolations, the obtained result cannot be directly regarded as true result, let alone the so-called true result obtained in this way can be extracted into physical laws or natural science theories. Therefore, after reaching the conclusion that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, it is reasonable for Maxwell to design and conduct another experiment, for example, a physical experiment shown in Figure 7, to determine whether the electromotive force is really generated by the component of a closed loop which is generating electromotive force with a change in magnetic flux inside it or not. That is, to design and conduct at least one physical experiment which must fully meet the requirements of his conclusion here, but completely different in terms of experimental composition from the physical experiment he just used for this issue to see if the conclusion works or not.

However, Maxwell did not make such a question, instead, he directly took this extrapolation result as the true electromagnetic nature of the world and extracted a conclusion that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the

electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop with it. In fact, regardless of whether this Maxwell's conclusion itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Maxwell's conclusion, there is no effective further confirmation of whether the extrapolation result is the nature or not was conducted, instead the extrapolation result is directly determined to be the nature and a physical conclusion is extracted with it. In a word, no matter whether this Maxwell's conclusion itself is true or not, its construction procedure is logically disordered.

Therefore, what Maxwell did here on this issue is not sufficient to establish scientific truth.

Furthermore, because Maxwell's conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, violates Faraday's law of electromagnetic induction, so it is false from its birth, therefore, there cannot possibly be any possibility for Maxwell's conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, to capture the true electromagnetic nature of the world and to hold true.

That is, there cannot possibly be any possibility for the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop to generate an electromotive force.

In summary, none of the following three equations captures the true electromagnetic nature of the world or holds true.

$$\oint E dl = - \frac{d\Phi_B}{dt}$$

$$\oint_L E \cdot dl = - \frac{d}{dt} \iint_S B \cdot ds$$

and

$$\nabla \times E = - \frac{\partial B}{\partial t}$$

7. Concerning the insufficient verification of Faraday's conclusion that an open coil with the change of magnetic flux in it produces an electromotive force

In 1832 in the physics experiment as shown in Figure 8, Faraday^[7] connects the ends of a multi-layer coil with wires to the metal ball and housing (ground) of a gold-leaf

electroscope. This appears to be the construction of an open coil, since this coil includes one end of the multi-layer coil, wires, gold-leaf electroscope metal balls, gold leaf, air gaps, gold-leaf electroscope housings, and the other end of the multi-layer coil. Then, as Faraday quickly inserted or pulled out a bar magnet into or out of the multi-layer coil, he observed the gold leaf of the gold-leaf electroscope opening and closing. Therefore, Faraday made a conclusion that an open coil with a change in magnetic flux inside it also generate an electromotive force. This is why the physics community has always believed that an open coil with a change in magnetic flux in the open coil also generates an electromotive force.

However, it is realized that Faraday's experiment of proving that an open coil with the change of magnetic flux inside it generating an electromotive force with a gold-leaf electroscope has a fatal logical error, and the conclusion that an open coil with the change of magnetic flux inside it produces an electromotive force is not true. It is believed that the circuit design for Faraday's experiment on this issue, shown in Figure 8, contradicts the purpose of the experiment, since this circuit design results in an experimental scenario that made the experiment was still completed under the condition of changing magnetic flux inside a closed loop, it's just that this closed loop includes an air gap.

However, because the matter in the air of the air gap contains electric charges, although these electric charges are not free to move to form an electric current, but under the action of the changing magnetic field (/the time-varying magnetic field), these electric charges can still form a certain amount of deflection which makes the loop including the air gap equivalent to the closed loop as a whole. In fact, the circuit Faraday used in this experiment is a closed loop containing displacement currents, because the gold-leaf electroscope is also essentially a capacitor, and the conductors on either side of the air gap are equivalent to the two plates of the capacitor.

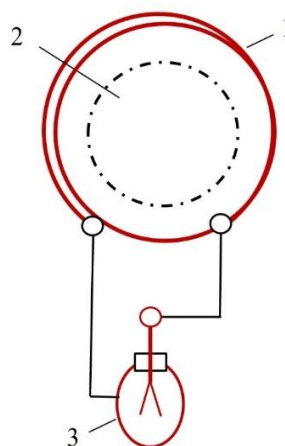


Figure 8. A schematic illustration of the device for the physical experiments by which Faraday obtains the conclusion that a change in magnetic flux within an open coil also generate an electromotive force. 1. Multi-layer coils, 2. The zone of time-varying magnetic fields, 3. Gold-leaf electroscope.

In fact, Faraday should have used the circuit setup shown in Figure 9, which can avoid the effect of the electromotive force generated by the change of magnetic flux in the closed loop composed of an electroscope, and then fundamentally determine whether an open coil with a change in the magnetic flux inside it can generate an electromotive force or not. If the opening and closing of the gold-leaf of the gold-leaf electroscope is observed in the experiment shown in Figure 9, then it can be concluded without controversy that an open coil with the change of magnetic flux inside it generates an electromotive force.

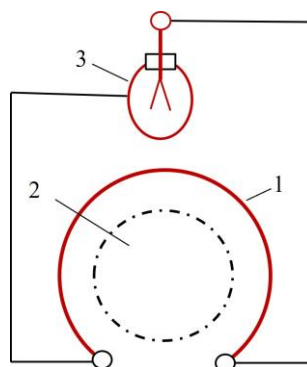


Figure 9. A schematic illustration of the device which should have been used to test if an open coil with changes in magnetic flux within it generates an electromotive force or not. 1. An open coil of less than one turn, 2. The zone of time-varying magnetic fields, 3. Gold-leaf electroscope.

Now, with physical experiment supported analyses shown below, the major scientific question of whether an open coil with the change of magnetic flux inside it can generate an electromotive force or not will be resolved. Why it is called a major scientific problem, because it reveals a totally different electromagnetic nature of the world, by whether an open coil with the change of magnetic flux inside it can generate an electromotive force or not. In fact, the device used by Faraday in his experiment to conclude that an open coil with changes in magnetic flux inside it produces an electromotive force (shown in Figure 8) is equivalent to the device shown in Figure 10.

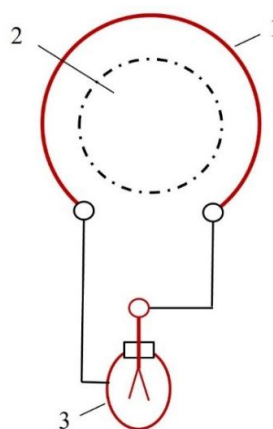


Figure 10. A schematic illustration of the device which is equivalent to the device for the physical experiments by which Michael Faraday obtains the conclusion that an open coil with changes in magnetic flux within it generates an electromotive force. 1. An open coil of less than one turn, 2. The zone of time-varying magnetic fields, 3. Gold-leaf electroscope.

Therefore, if the Faraday's conclusion that an open coil with a change in magnetic flux inside it produces an electromotive force holds true, then there must be voltage between two points of each of these voltage-measurement point pairs A_1 and A_2 , A_2 and A_3 , A_3 and A_4 , and B_1 and B_2 , shown in Figure 11. As shown in Figure 11, the distance on coil between the two voltage-measurement points of each of the four voltage-measurement pairs A_1 and A_2 , A_2 and A_3 , A_3 and A_4 , and B_1 and B_2 is one-ninth of the length of the entire open coil. Therefore, if the Faraday's conclusion that an open coil with a change in magnetic flux inside it produces an electromotive force holds true, then the voltage between the two voltage-measurement points of each voltage-measurement pair should be about one-ninth of 0.717V, that is, about 0.080V, because if this open coil is turned into a closed loop, the measured voltage of this entire closed loop is 0.717V. In order to determine whether

there is any voltage between the two voltage-measurement points of each voltage-measurement pair, the voltage across the two voltage-measurement points of each voltage-measurement pair were measured, and the result was that the voltage across the two points of every pair was 0.000V, with a Voltmeter (with a resolution of 1 millivolt) .

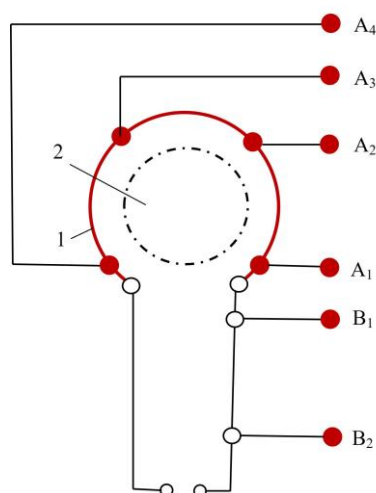


Figure 11. A schematic illustration of the device which is to test the validity of the Michael Faraday's conclusion that open coil with changes in magnetic flux within it generates an electromotive force. 1. An open coil of less than one turn of the secondary coil of a transformer of 1kW, 220V, 50 Hz, 2. The transformer core of 1kW, 220V, 50 Hz with the transformer primary coil on, A₁, A₂, A₃, A₄, B₁, and B₂ are the voltage measure points, the distance on coil between the two voltage-measurement points of each of the four voltage-measurement pairs A₁ and A₂, A₂ and A₃, A₃ and A₄, and B₁ and B₂ is one-ninth of the length of the entire open coil.

Not only that, there cannot possibly be voltage between the two points of any of these voltage-measurement point pairs A₁ and A₂, A₂ and A₃, A₃ and A₄, and B₁ and B₂, shown in Figure 11. Because if there is voltage between the two points of any of these voltage-measurement point pairs, then electrical power can be delivered with a single wire. That is, a single wire can be used to transport electricity from the electric generator to a distance, and then according to the required voltage, two points of the corresponding distance are taken on this wire for voltage matching and power supply, so that even the transformer can be eliminated. This is obviously and absolutely ridiculous and absurd. Therefore, there cannot possibly be voltage between the two points of any of these voltage-measurement point pairs.

Therefore, Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force fails to capture the true electromagnetic nature of the world and does not hold true. The fatal logic error of Faraday's experiment on this issue is that the logic error of the circuit setting of his experiment leads to an illusion that the generation of electromotive forces is under the change of magnetic flux in an open coil, but in fact, it is still under the change of magnetic flux in a closed loop as a whole.

In summary, an open coil with a change in magnetic flux within it does not generate an electromotive force. Again, only a closed loop with the change of magnetic flux inside it can generate an electric field, an electromotive force, and an electric current. A time-varying magnetic field can only generate an electric field, an electromotive force, and an electric current through a closed loop.

Logically, in a process of scientific experiments, the observed phenomena cannot be directly regarded as the nature, let alone the so-called nature obtained in this way can be

extracted into physical laws or natural science theories. Therefore, after obtaining the phenomenon that an open coil with a change in magnetic flux inside it generates an electromotive force with the experiment stated in Figure 8, it is reasonable for Faraday to design and conduct another experiment which is completely different in terms of experimental composition from the physical experiment shown in Figure 8, for example, a physical experiment shown in Figure 11, to determine whether the electromotive force is really generated by an open coil with a change in magnetic flux inside it or not. That is, to design and conduct at least one physical experiment which must fully meet the requirements of his conclusion here, but completely different in terms of experimental composition from the physical experiment he just conducted for this issue to see if the conclusion works or not.

However, Faraday did not make such a question, instead, he directly took this phenomenon as the true electromagnetic nature of the world and extracted Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force with it. In fact, regardless of whether Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force, there is no effective further confirmation of whether the observed phenomenon is the nature or not was conducted, instead the observed phenomenon is directly determined to be the nature and a physical conclusion is extracted with it.

In a word, no matter whether Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force itself is true or not, its construction procedure is logically disordered.

Therefore, what Faraday did here on this issue is not sufficient to establish scientific truth.

Furthermore, because Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force is built upon false phenomenon rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for this Faraday's conclusion that an open coil with a change in magnetic flux inside it generates an electromotive force to capture the true electromagnetic nature of the world and to hold true. That is, there cannot possibly be any possibility for an open coil with a change in magnetic flux inside it to generate an electromotive force.

8. Concerning the insufficient verification of Maxwell's conclusion that a changing magnetic field forms a changing electric field in an empty space, that is a vortex electric field in an empty space (vacuum)

Since he believes that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, and believes that an open coil with the change of magnetic flux in it generate electromotive force, therefore, Maxwell concludes that a changing magnetic field (/a time-varying magnetic field) must generate a changing electric field (/a time-varying magnetic field) in an empty space, that is, a vortex electric field in an empty space (vacuum). That is, an extrapolation with a broken chain of reasoning was conducted to believe that a changing magnetic field generates a vortex electric field in an empty space (vacuum), no need for a closed loop or matter to

be involved. In fact, this extrapolation omitted the closed loop which is the necessary conditions for the generation of an electric field and an electromotive force from magnetic fields, stated by Faraday's law of electromagnetic induction. Further, Maxwell subjectively determine that the curl of the electric field is equal to the negative value of the time rate of changes in magnetic flux density.

Logically, in a process of scientific extrapolations, the obtained result cannot be directly regarded as true result, let alone the so-called true result obtained in this way can be extracted into physical laws or natural science theories. Therefore, after reaching the conclusion that the curl of the electric field is equal to the negative value of the time rate of changes in magnetic flux density in an empty space (vacuum), it is reasonable for Maxwell to design and conduct an experiment, for example, a physical experiment shown in Figure 7 or a physical experiment shown in Figure 11, to determine whether the curl of the electric field is really generated or not. That is, to design and conduct at least one physical experiment which must fully meet the requirements of his conclusion here, but completely different in terms of experimental composition from the physical experiment he just used for this issue to see if the conclusion works or not.

However, Maxwell did not make such a question, instead, he directly took this extrapolation result as the true electromagnetic nature of the world and extracted a conclusion that the curl of the electric field is equal to the negative value of the time rate of changes in magnetic flux density in an empty space (vacuum) with it. In fact, regardless of whether this Maxwell's conclusion itself is true or not, this procedure is obviously illogical, because that in the process of constructing this Maxwell's conclusion, there is no effective further confirmation of whether the extrapolation result is the nature or not was conducted, instead the extrapolation result is directly determined to be the nature and a physical conclusion is extracted with it. In a word, no matter whether this Maxwell's conclusion itself is true or not, its construction procedure is logically disordered.

Therefore, what Maxwell did here on this issue is not sufficient to establish scientific truth.

Furthermore, because this Maxwell's conclusion, that the curl of the electric field is equal to the negative value of the time rate of changes in magnetic flux density in an empty space (vacuum), is built upon false phenomenon rather than on the nature, so it is false from its birth, therefore, there cannot possibly be any possibility for Maxwell's conclusion, that the curl of the electric field is equal to the negative value of the time rate of changes in magnetic flux density in an empty space (vacuum), to capture the true electromagnetic nature of the world and to hold true. That is, there cannot possibly be any possibility for a changing magnetic field forms a changing electric field or forms a vortex electric field in an empty space (vacuum).

In fact, if a time-varying magnetic field induces a time-varying electric field in an empty space (vacuum), producing a vortex electric field, that is, if a time-varying magnetic can induce a time-varying electric field, producing a vortex electric field without the participation of any matter, then there must be voltage between the two voltage-measurement points of each of the voltage-measurement point pairs C_1 and C_2 , C_2 and C_3 , C_3 and C_4 , and D_1 and D_2 , shown in Figure 7, and the conductors in the time-varying magnetic field or at its edge of the time-varying magnetic field must generate an electromotive force.

However, in an empty space (vacuum) where there is no closed loop, in an empty space where there is no matter, a time-varying magnetic field cannot possibly generate an

electric field or a vortex electric field. Because once a time-varying magnetic field can generate an electric field in an empty space or a vortex electric field in an empty space, there must be voltage difference between any two points on a conductor segment which exists in the vortex electric field or at the edge of the vortex electric field, and there must be voltage difference between any two points on the less than one turn conductor segment of an open coil which exists in the vortex electric field or at the edge of the vortex electric field. Not only that, there must be voltage difference between any two points on any matter segment (which can be non-conductor) which exists in this vortex electric field or at the edge of the vortex electric field, and there must be voltage difference between any two points of any matter which exists in this vortex electric field or at the edge of the vortex electric field. However, there is no voltage at all as proved by the experiments illustrated in Figure 11. In addition, same as this, a time-varying electric field cannot generate a magnetic field in an empty space (vacuum), either.

In other words, if a time-varying magnetic field can generate an electric field, can generate a vortex electric field, can generate an electromotive force, or can generate an electric current, without matter involved, which forms closed loops, then there must be a voltage between the two points of each of these voltage-measurement point pairs A_1 and A_2 , A_2 and A_3 , A_3 and A_4 , and B_1 and B_2 , shown in Figure 11, but in fact, there is no voltage and there cannot possibly be voltage between the two points of any of these voltage-measurement point pairs, as stated above. This indicates that a time-varying magnetic field cannot generate an electric field, cannot generate a vortex electric field, cannot generate an electromotive force, and cannot generate an electric current, if there is no matter involved, which forms closed loops.

In fact, it is not true that a time-varying magnetic field generates a vortex electric field first, or a time-varying magnetic field generate a vortex electric field in an empty space (vacuum). However, it is true that a time-varying magnetic field generates a vortex electric field in a place where there is matter, or there is the combination of matter and empty space (vacuum). Therefore, the Maxwell's equation, that the negative value of the time rate of the change of magnetic flux density is equal to the curl of the electric field, which indicates that a time-varying magnetic field can induce a vortex electric field in a place where nothing exists, is not true.

However, even if it is assumed that there is voltage between the two points of each of these voltage-measurement point pairs C_1 and C_2 , C_2 and C_3 , C_3 and C_4 , and D_1 and D_2 , shown in Figure 7, and even if it is assumed that a conductor in the time-varying magnetic field or at its edge of the time-varying magnetic field generate an electromotive force, the assertion, that a time-varying magnetic field induces electric fields in an empty space (vacuum), inducing a vortex electric field, is also logically disturbed. Because this assertion excludes the necessary conditions for the process, that is, the closed loop or its substitute, or say matter. The substitute can even be an insulator, but it is indispensable, because whether it is a conductor closed loop or other material closed loop only affects the magnitude, but not the existence or absence of the necessary condition, which is indispensable. In fact, a closed loop as a whole is a necessary condition for this process.

In addition, because Maxwell mistakenly trusts and believes that the false conclusion, that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, holds true, and mistakenly believes that

the false conclusion, that an open coil with the change of magnetic flux in it generate electromotive force, holds true, then he formulates the equation stated below:

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

which fails to capture the true electromagnetic nature of the world and does not hold true.

9. Discussion

Electromagnetism, electrodynamics and Maxwell's equations are very important and time-tested fields, and so many fatal problems found in this paper still exist in such fields, which shows that humans must further promote critical education and critical scientific research.

This paper may scientifically prove that phenomenon observed in an experiment may be not the nature, the empirical consistency with phenomenon is insufficient to establish scientific truth. In fact, human scientific and technological civilization is not built on consistently stable physical laws and consistently stable natural science theories, but on the continuous evolution of physical laws and natural science theories. Therefore, falsifying existing physical laws and natural science theories is not a transgression, but a logical necessity. The falsified physical laws and theories and their founders are not losers, but the great founders and great contributors of the existing scientific and technological civilization, but the solid shoulders of the great giants for those who are on the way to create new physical laws or new natural science theories.

The fact that so many problems were found in the fundamental laws and the fundamental theories as stated above does not mean that the electromagnetic scientists of that time and their achievements are not great enough, but only that the scientific and technological knowledge system and the way of understanding of the physical laws and natural science theories have evolved. I only found several problems because that the project to develop totally new electric motors based on the fundamental laws and the fundamental theories of electromagnetism completely failed eight years ago, then I had to climb on the shoulders of scientific giants such as Oersted, Ampère, Faraday, Lorentz, Biot-Savart and Maxwell to search for the solutions. Standing on their shoulders, I discovered the problems explained in this paper. They are indeed great when they could make such a significant contribution in that era when the knowledge system and detection methods of electromagnetic relations were almost blank.

Electromagnetism, electrodynamics and Maxwell's equations to date do not realize that a closed loop of one turn as a whole is the smallest indispensable physical unit that generates electromagnetic phenomena, instead consider elements which are smaller than a closed loop of one turn as a whole and even an empty space can generate electromagnetic phenomena. That is, electromagnetism, electrodynamics and Maxwell's equations to date do not realize that: The induced magnetic field is not generated by current itself, but by the changing current's closed loop as a whole, and the induced electromotive force is not generated by the components of a closed loop with changes in magnetic flux inside the closed loop, but by the closed loop as a whole with changes in magnetic flux inside the closed loop. The closed loop here is not necessarily the closed loop of the conductor, it is the closed loop of matter. The current here refers to the total current, that is, it includes

conduction current, displacement current and convection current.

Since physical law and natural science theory not only need to coinciding with certain and certain types of physical experiments, but also with all the different experiments in its jurisdiction, including all different types of experiments. Therefore, as stated in the conclusion, in order to prove the validity of physical law and natural science theory, it is necessary but not sufficient to confirm the reproducibility of the experiment that the relevant physical law and natural science theory are extracted form. At the very least, it must be confirmed that the relevant physical law and natural science theory are still consistent with the results of the physical experiment in the following physical experiment B. If a physical law X (or natural science theory X) is extracted from a physical experiment A, the reproducibility of the physical experiment A is only sufficient to verify the validity of the physical experiment A itself, but not sufficient to verify the validity of the physical law X, and at least one more physical experiment B should be designed and conducted to verify the validity of the physical law X. The physical experiment B must fully meet the requirements of the physical law X, but the physical experiment B must be completely different in terms of experimental composition from the physical experiment A. If the results of the physical experiment B are still consistent with the explanation of the physical law X, then the physical law X can be considered to be scientific truth. Otherwise, the physical law X is not sufficient to be scientific truth. If the physical experiment B cannot be found, then the physical law X can be considered to be temporarily true, but if the physical experiment B is found one day, it should still be verified as such.

The physical experiment A or any empirical experiment of its kind is sufficient to verify the experiment itself, but not sufficient to establish scientific truth and not sufficient to verify the scientific truth which is extracted from the physical experiment A, either.

In the extraction process of all the physical laws and natural science theories discussed in this paper, why what the scientist did is not sufficient to establish scientific truth, is just because that they did not realize the decisive role of the physical experiment B, and did not conduct the physical experiment B.

10. Conclusions

In this study, it is discovered that: Oersted's law of electromagnetism which states that a current-carrying conductor generates a circular magnetic field surrounding the conductor, Ampère's force law which states that a current-carrying conductor experiences a force in a magnetic field, Faraday's law of motional electromotive force which states that a conductor cutting through magnetic field lines generates an electromotive force, Lorentz force law which states that a moving charge experiences a force in a magnetic field, Biot-Savart law which provides a method to calculate the magnetic field at a point in space generated by a steady electric field, Ampère's circuital law which states that the line integral of the magnetic flux density around a closed loop is equal to the product of the permeability of the medium multiplied by the current passing through the closed loop, Ampère-Maxwell's law which states that the line integral of the magnetic flux density around a closed loop is proportional to the sum of the conduction current and displacement current passing through the closed loop, Maxwell's conclusion that the component of a closed loop generating electromotive force and electric current due to a change in magnetic flux in the closed loop generates electromotive force and the electromotive force of the closed loop as a whole is equal to the integral of the electromotive force generated by the components of the closed loop, Faraday's conclusion that an open coil with the change of magnetic flux

in it produces an electromotive force, and Maxwell's conclusion that a changing magnetic field forms a changing electric field in an empty space and forms vortex electric field in an empty space (vacuum) all lack sufficient verification, all fail to capture the true electromagnetic nature of the world and all are not scientific truth. They do not hold true.

This study also clarifies that: If a physical law X (or natural science theory X) is extracted from a physical experiment A, the reproducibility of the physical experiment A is only sufficient to verify the validity of the physical experiment A itself, but not sufficient to verify the validity of the physical law X, and at least one more physical experiment B should be designed and conducted to verify the validity of the physical law X. The physical experiment B must fully meet the requirements of the physical law X, but the physical experiment B must be completely different in terms of experimental composition from the physical experiment A. If the results of the physical experiment B are still consistent with the explanation of the physical law X, then the physical law X can be considered to be scientific truth. Otherwise, the physical law X is not sufficient to be scientific truth. If the physical experiment B cannot be found, then the physical law X can be considered to be temporarily true, but if the physical experiment B is found one day, it should still be verified as such.

This study also clarifies that the root cause for why so many laws and theories are not true in electromagnetism, electrodynamics and in Maxwell's equations is that the scientific and technological sages of that year confused the role of experiment A and experiment B described above; and the root cause for why the scientific and technological community has not discovered these problems for almost two hundred years is that the scientific and technological community confuses the role of experiment A and experiment B described above.

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Author Declarations

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