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Physical Interpretation of Electricity and Magnetism and Electromagnetic Induction

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Abstract

Electricity and magnetism and electromagnetic induction are phenomena that can be perceived by people. But their interpretation and theoretical study took a long time. The theoretical research on electricity began with the discovery of Coulomb's law in 1785, while the theoretical research on magnetism began with the discovery of Oersted's Law in 1820. From the 1850s to the 1870s, Maxwell summarized a set of theoretical equations for electromagnetism based on some laws of predecessors. However, this set of equations contains a few statistical relationships and empirical concepts, so it is difficult to explain the physical nature of electromagnetic phenomena and principles. This paper explained that the macro phenomenon of electricity is the separation of unlike charges of new electrons produced by the orthogonal collision of old particles under the action of external forces. The physical nature of magnetism is the potential energy (magnetic energy) and information associated with the overall orientation of the moving electrons solidly recorded in the material. The physical principle of electromagnetic induction describes how change in electric current intensity generates change in magnetic intensity and *vice versa* through orthogonal interaction of ordered electrons. This theoretical interpretation does not require the concepts of traditional electromagnetic forces, electromagnetic fields, magnetic moments, and magnetic domains.

Keywords

Electricity, Magnetism, Physical Interpretation, Orthotropic Collision, Unlike Charge, Electromagnetic Induction

1. Introduction

The steady advancement of electromagnetism has given birth to various inse-

parable electrical technologies. But the understanding of electricity and magnetism has gone through thousands of years. As early as 600 BC, the ancient Greek mathematician and philosopher named Thales [1] observed the phenomenon of static electricity in amber rubbed with cloth known as the triboelectric effect, so he tried to give a reasonable explanation. Starting with him, scientific pioneers, such as ancient Greek philosopher and polymath Aristotle (348-322 BC) and ancient Greek mathematician and physicist Archimedes (287-212 BC) [2], first proposed tentative hypotheses about observed phenomena, then tested experimentally, further explained, and corrected, and finally formed a law or theory. This has become the basic rule of early scientific research.

In the 2000 years after Thales, electricity research came to a near standstill. It was not until 1600 AD that the English physicist and natural philosopher William Gilbert regarded as the "Father of Magnetism" gave the Latin term "electricus" and studied the Earth's magnetic field and the properties of magnetic materials [3] [4]. For the first time, he thought that electricity, like fluids, could stand still (static electricity) or flow (electric current). In 1733-1734, French physicist Charles du Fay discovered positive and negative charges as well as the opposite interactive phenomenon of unlike charges attracting each other and like charges repelling each other [5]. American polymath Franklin (1706-1790) [6] learned the mystery of static electricity and electric current from atmospheric lightning which conducted by his famous kite experiment in 1752. He proposed the principle of conservation of charge. In 1785, French physicist Coulomb (1736-1806) [7] [8] formulated the principle known as Coulomb's law, quantitatively describing the electrostatic force between two charged particles. The law states that the force between two charges is directly proportional to the product of their magnitudes and inversely proportional to the square of the distance between them. In 1800, Italian physicist and chemist Volta invented the first electric battery [9].

The understanding of magnetism dates to China's Qin Dynasty (221-206 BC), when the magnetic compass was invented to indicate true north. In the next 2000 years, electricity and magnetism were not linked. Up to 1820, Danish physicist and chemist Oersted [10] discovered what would become known as Oersted's Law: that an electric current creates a magnetic field in its surrounding space affecting a nearby compass needle in his experiment. It revealed that the magnetic field produced by the current can exert forces on magnetic materials and other nearby conductors carrying current. He made a crucial milestone on the magnetic field and magnetic force and in the development of electromagnetism. French physicist Ampère (1775-1836) [11] formulated a law stated that the magnetic field created by an electric current is proportional to the current flowing through a conductor and the distance from the conductor, which announced his theory of electrodynamics in 1821. In 1831, the English scientist Faraday (1791-1867) [12] discovered that a changing magnetic field induces an electric current in a nearby conductor. This principle is known as Faraday's law of electromagnetic induction. It states that the electromotive force (EMF) induced in a

closed loop is directly proportional to the rate of change of magnetic flux through the loop. Since then, electromagnetic fields and electromagnetic forces have conceptually entered the historical stage of electromagnetism.

From 1785 to 1831, Coulomb, Oersted, Ampère, Faraday and others proposed relevant statistical mathematical laws based on experimental electromagnetic observations. However, these experimental results and rules were not well organized and sometimes confusing to scientists. A comprehensive summary of the electrodynamic principles was in urgent need at that time [13]. This work was done by Scottish physicist Maxwell through a series of papers published from the 1850s through to the 1870s, particularly in the 1860s [14] [15] [16] [17] [18]. He noticed the dispersion between these laws, so he wanted to integrate them mathematically. Maxwell's original system of equations developed in 1865 consisted of 20 equations and 20 variables. Maxwell analyzed his system of equations and foresaw the existence of electromagnetic waves. For equations that still appear complex, he attempted to express them in quaternions in 1873, but it was not successful [19]. A hundred years later, English mathematician and physicist Heaviside [20] experimented with different methods to finally give the vector mathematical form of the present system of equations in 1884. German physicist Hertz [21] in 1887 conducted experiments to verify Maxell's prediction of the existence of electromagnetic waves.

Maxwell's equations are a mathematical unification of two micro invisible but macro perceptible phenomena of electricity and magnetism. Since those laws are empirical, his system of equations still has statistical constants. Heaviside's final four equations described the mathematical relationships of electricity, magnetism, and the electromagnetic induction which states that moving electric charges generate a magnetic field and the strength of the magnetic field is proportional to the speed and density of the moving charges. Electric field and magnetic field act as the linkage between electricity and magnetism. So, this set of equations is conceptually harmonious and mathematically perfect. We have a deep understanding of electricity and magnetism and can apply them to explain and predict phenomena. Such a set of Maxwell's equations has unified electricity and magnetism as electromagnetism. But the physical nature of electromagnetic phenomena and the physical principles of electromagnetic induction, particularly what are the magnetic moments and magnetic domains are still unclear in micro level. The fundamental question is what the origin of electric field and magnetic field. This article first clarifies the different concepts of force and inertial motion in Section 2. Section 3 gives the various dynamics of four ways of interactions (collisions) between particles such as electrons and other materials. Section 4 uses these dynamics to explain the physical nature of electricity and magnetism. Section 5 describes the physical principles of electromagnetic induction. Finally, Section 6 gives a conclusion and discussion to this article.

2. Force and Inertial Motion

All objects (particles) in the cosmic vacuum are moving in inertia. To change

their inertial motion, it is necessary to give an external force. On the rotating Earth, the following forces $\boldsymbol{F}'$ are known,

$$\boldsymbol{F}' = -m\boldsymbol{g} - 2m(\boldsymbol{\Omega}\times\boldsymbol{v}) - m\boldsymbol{\Omega}\times(\boldsymbol{\Omega}\times\boldsymbol{r}') - m\mathrm{d}\boldsymbol{\Omega}/\mathrm{d}t\times\boldsymbol{r}'. \quad (1)$$

Here, m is the mass of an object (particle). $g = GM/r'^2$, G is the gravitational constant, M is the mass of Earth, $\boldsymbol{\Omega}$ is the rotating angular velocity of the Earth, $\boldsymbol{v}$ is the velocity of the object (particle) relative to the rotating Earth, $\boldsymbol{r}'$ is the position vector of the object (particle) relative to the Earth' center. In Equation (1), the term $-m\boldsymbol{g}$ is the force on an object (particle) acted upon by Earth's gravitational force, the $-2m(\boldsymbol{\Omega}\times\boldsymbol{v})$ is the Coriolis force, the term $-m\boldsymbol{\Omega}\times(\boldsymbol{\Omega}\times\boldsymbol{r}')$ is the centrifugal force, and the term $-m\mathrm{d}\boldsymbol{\Omega}/\mathrm{d}t\times\boldsymbol{r}'$ is the Euler force indicating the variation of $\boldsymbol{\Omega}$ with time.

The last three terms at the right-hand side of Equation (1) are all related to the Earth's rotation $\boldsymbol{\Omega}$. The magnitude of the last two terms is small, and only the second term is something we can feel. When considering particles per unit mass, the Coriolis force is,

$$\boldsymbol{F}_C' = -2(\boldsymbol{\Omega}\times\boldsymbol{v}). \quad (2)$$

For the movement of the atmosphere, the Coriolis force is perpendicular to the plane formed by $\boldsymbol{\Omega}$ and $\boldsymbol{v}$. In the Northern Hemisphere it is pointing to the right of airflow direction $\boldsymbol{v}$, and in the Southern Hemisphere it is pointing to the left of airflow direction $\boldsymbol{v}$. At the equator it is zero while it reaches the largest at the two polar points. Therefore, tropical cyclones cannot be generated on the equator, and the airflow in the northern cyclone rotates counterclockwise around its center, while the airflow in the southern cyclone rotates clockwise around its center. The Coriolis force is not a real force, but the inertia, or potential energy, formed by the inertial rotation of atmospheric air parcels with the inertial rotation of the Earth. The potential energy can be released only when air parcel has a relative velocity $\boldsymbol{v}$ to the rotated Earth $\boldsymbol{\Omega}$. The essence of this inertial motion comes from when the Earth was formed. The Coriolis force or the deflection force of the Earth's rotation is just an illusion.

In Equation (1), the first term is the Newton's gravitational pull, of which magnitude is proportional to the masses of the Earth and the object (or particle), and inversely proportional to the particle's distance relative to the center of the Earth,

$$\boldsymbol{F}_n' = -m\boldsymbol{g} = -G(Mm)/r'^2\,\boldsymbol{n}_r. \quad (3)$$

where $\boldsymbol{n}_r$ is the unit vector along $\boldsymbol{r}'$. An apple leaves the branch that grew it and can fall freely to the ground. People did not feel that the static apple on the ground was affected by an external force, but people saw the apple landing on the ground and thought that it was affected by an external force. In fact, the natural landing of apples is also an inertial motion. Throwing an object into the upper air requires force to change its inertial motion. External forces, such as one puts an apple from the ground to the branch, change the inertia of an object (apple), so that work is done on the object (apple) and increase its inertial energy

or geopotential energy. When the apple falls from the branch, the geopotential energy is partially converted into kinetic energy, so that acceleration occurs.

The Coriolis force and gravity are essentially inertia or potential energies that an object (particle, air parcel, apple) has. The Coriolis force of particles with a velocity on the Earth's surface gradually reaches maximum at the two poles from zero at the equator. In Equation (1), except of the second term, others express the inertia of objects (particles) on the Earth depending on the distance $\boldsymbol{r}'$ from the center of the Earth. Equation (1) means that every object (particle) in the Earth system has four components of inertia. Four components form their centers of the inertial motion of objects (particles). The Earth's atmosphere, seawater, and objects (particles) inside the Earth all have their inertial motion relative to their centers. The inertial motion of an object (particle) relative to its center at the macro scale has been described here.

In a system formed by the Earth and the Moon, their inertial motion centers on their common center of mass. In the system of planets of the solar system, their center of inertial motion is on the Sun. As a giant celestial system, the center of inertial motion of all stars is on the center of the Milky Way. Every system can be looked at as a universe. The inertial motion of an object (particle) begins when its universe is formed. The formation of the solar system begins the trajectory of each planet relative to the Sun, including precession on multi-space-time scales [22]. The inertial motion of an object (particle) relative to its center on the cosmic scale has been described here.

Similarly, we now describe the inertial motion of particles on a micro scale. In 1909, New Zealand physicist Rutherford experimentally inferred the existence of dense nucleus at the center of the atom [23]. In the atomic model, the nucleus is made up of protons and neutrons, and electrons move around the nucleus. Electrons are the most active particles in atoms. Different substances have different atoms and electrons moved around their nucleus with inertial motion. Such an atomic model and the movement of many electrons relative to the nucleus are like the rotation of planets around the Sun, or the rotation of satellites around a planet. The number of atoms of matter and the arrangement of numerous electrons in each atom and their inertial motion originate from the formation of matter and atoms. For the inertial motion of each particle not only in the cosmic system but also in the macro and micro systems, it comes down to the formation of original systems.

In the solar system, if you want to change the inertia of an asteroid (change its trajectory), you need an external force. In the Earth system, if you want to change the inertia of a moving object, you need the action of an external force. Similarly, in an atomic system, if you want to change the inertia of an electron, you also need the action of an external force. The action of external forces is to do work on an object (particle) and increases its energy of inertial motion, *i.e.*, potential energy.

In the universe, the fastest rate of inertial motion is the photons emitted from stars. As the closest star to us, there are inertial relative motions between spheres

or layers in the Sun's interior. The relative motion of different mass parcels on a star creates collisions between particles, producing new particles with little mass but high speed. This process is a thermonuclear reaction that takes place on a star. These new particles escape the inertial shackles of the star and radiate out into the outer space of the star or the Sun. These new particles radiated out are photons. Because different stars have different abilities to produce new particles or photons to escape, massive stars have greater speed of light and the lightest mass of particles with the highest energy. The lightest mass and the highest energy may be the dark matter and the dark energy, which cannot be measurable. On stars of different masses, the chance, angle, and intensity of collision of adjacent mass parcels of material are different, resulting in stellar storms, such as sunspot activity with strong radiations reaching the Earth. Solar storms can excite the Earth's auroras [24].

The photon radiated by the Sun is an electromagnetic wave [25]. The propagation of both light and energetic particles is characterized by wave-particle duality [26] [27]. In the real world, the trajectories of matter or particles at cosmic, macro, and micro scales are curved. The formation of these substances (particles) and the formation of curved inertial motion are traces left by them when the universe was formed, and they are also the inertial energy left behind. Our topic should gradually become clear, the solidified magnetism on a material is the inertial energy left by the inertial motion of electrons in history, and the instantaneous magnetism is the inertial energy formed by the instantaneous current change.

English mathematician and physicist Newton used statistical mathematics to give the so-called gravitational pull of people's senses, such as Equation (3). Not any two adjacent objects (particles) in the universe have this statistical relationship if they have not internal physical connection. Such physical relationships exist between the Sun and its planets, between a planet and its moons, between objects (particles) on the Earth's surface and the Earth's center, and between an atom with its electrons. Such physical relationships do not exist between planets [22], between human and plants, and between photons and Earth. Some statistical relationships, such as the Sun and its planets as well as objects (particles) on the surface relative to the Earth's mass center, have brought great convenience to people's production and life. People recognize many statistical relationships in practice. Statistical relationships can work, but it is difficult to explain physical attribution between things.

Two centuries after Newton's universal gravitational force was proposed, German-born theoretical physicist Einstein did not recognize this force acting at a distance. Therefore, in 1915 he proposed the general theory of relativity [28], replacing the gravitational action at a distance with the mass-energy space-time distribution of objects (particles). Einstein used geometric mathematics to describe the space-time relationship between many objects (particles) in the universe. However, Einstein did not make it clear that the universe he described

should also be a geometric relationship between a central body and many members of the system. Newton's gravitational equation only considered the statistical relationship between two objects (particles). General relativity considers the mass, energy, rotation, and revolution of all objects (particles) in a universe, so his equations can predict the precession of Mercury more accurately than Newton's gravitational law [22].

Newtonian gravity is a statistical description of two adjacent objects (particles) in an attracted relationship. General relativity uses geometric mathematics to describe the attraction of all its members by the largest object in a system. Whether it is statistical mathematical attraction or geometric algebra attraction, they all have gravitational constants that change with different systems. Statistical constants inevitably lead to deviations between the results of calculations and observations. This attraction of a large object to small objects is a passive form such as gravity.

The inertial motion of an object (particle) is described as a gravitational action, in which a medium of force is required. The early ether was denied, and the later graviton could not be found. Thus, one uses the concept of gravitational field to describe the existence of gravity (gravitational force). The worldview that human beings have formed for a long time is indeed confused by superficial phenomena. An opposing worldview is the active convergence of large and small objects in a system toward their system center. The convergence of objects (particles) follows an inertial motion. Our later dynamics is to introduce the process and result of the active inertial convergence or collision of objects (particles). Collisions between old objects (particles) can produce the inertial motion of new particles. Thus, two distinct worldviews namely the gravitational worldview and the inertial worldview can be proposed in this paper.

3. Four Ways of Particle Collision

What is hidden is that it is not clear how the inertial motion of objects (particles), such as geo-deflection motion and free fall, is produced. It is directly linked with the origin of each universe, such as the formation of cosmic, macro, and micro systems. A new universe is originated from an orthogonal collision. We can group collisions between objects (particles) into four ways. In the following collision analysis, for simplicity and clarity, we simply collide with two (or four) particles instead of two-beam particles.

Figure 1(a) shows that the collision between two particles has an angle θ. According to the previous discussion, the inertial motion of cosmic-, macro- and micro-objects and particles in nature is in the form of curves. In 1927, two American scientists Davisson and Germer made a so-called Davisson-Germer experiment [29] which provided evidence for the wave-like nature of electrons. As a result, the curved or wave-like motion of the colliding particles has a centripetal force. The centripetal forces of two particles $\boldsymbol{F}_A$ and $\boldsymbol{F}_B$ are respectively,

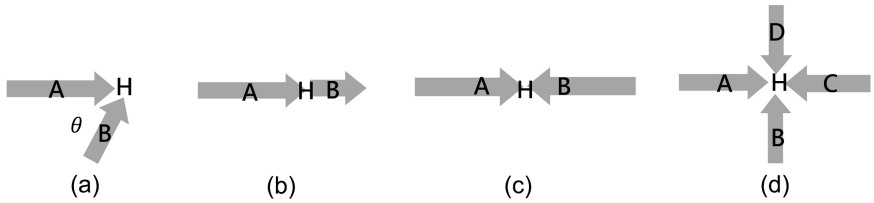

Figure 1. Four schematic ways of collision. (a) The cross collision caused by two particles A and B with a colliding angle θ; (b) The rear-end collision caused by a particles A and a low velocity particle B; (c) The head-on collision caused by two particles A and B; (d) The orthogonal collision caused by four particles A, B, C and D. The letter H indicates the collision point.

$$\boldsymbol{F}_A = \frac{m_A}{r_A} v_A^2 \boldsymbol{n}_A, \tag{4}$$

and

$$\boldsymbol{F}_B = \frac{m_B}{r_B} v_B^2 \boldsymbol{n}_B. \tag{5}$$

where m_A and m_B are the masses of two particles, v_A and v_B are their velocities, r_A and r_B are their radiuses, $\boldsymbol{n}_A$ and $\boldsymbol{n}_B$ are unit vectors. At the point H, the shear stress caused by the collision of two particles is,

$$\boldsymbol{\tau}_{Ha} = \boldsymbol{F}_A \times \boldsymbol{F}_B =\!\!\| \left(\frac{m_A}{r_A} v_A^2\right) \cdot \left(\frac{m_B}{r_B} v_B^2\right) \left(\boldsymbol{n}_A \times \boldsymbol{n}_B\right). \tag{6}$$

In Figure 1(a), the direction of the shear stress $\boldsymbol{\tau}_{Ha}$ is perpendicular to the plane of two vectors $\left(\boldsymbol{n}_A \times \boldsymbol{n}_B\right)$. The symbol "$=\!\!\|$" in Equation (6) indicates that the quantities (vector and scalar) on both sides represent events in the two different worlds (universes). This symbol indicates that the magnitudes on both sides are equal, but the information on both sides cannot be communicated. From the new world (new universe) $\boldsymbol{\tau}_{Ha}$, people cannot find any information even appeared in the old world (old universe) such as $\left(\frac{m_A}{r_A} v_A^2\right)$ and $\left(\frac{m_B}{r_B} v_B^2\right)$. Similarly, no information of the new world (new universe) existed in the old world (old universe). Equation (6) expresses a very meaningful philosophical question.

The shear stress modulus or the magnitude of the shear stress is,

$$\tau_{Ha} =\!\!\| \left(\frac{m_A}{r_A} v_A^2\right) \cdot \left(\frac{m_B}{r_B} v_B^2\right) \sin\theta. \tag{7}$$

The shear stress modulus reaches the maximum only when their angle between $\boldsymbol{n}_A$ and $\boldsymbol{n}_B$ is 90 degrees or 270 degrees. This is an orthogonal convergence or orthogonal collision of two particles when $\theta = 90$ degrees,

$$\tau_{HaM} =\!\!\| \left(\frac{m_A}{r_A} v_A^2\right) \cdot \left(\frac{m_B}{r_B} v_B^2\right). \tag{8}$$

In addition, the collision of two particles will produce a total energy,

$$E_T = E_A - E_B\left(\boldsymbol{n}_A \cdot \boldsymbol{n}_B\right) = \frac{1}{2}m_A v_A^2 - \frac{1}{2}m_B v_B^2 \cos\theta . \quad (9)$$

Here, the point multiplication of the two vectors $\left(\boldsymbol{n}_A \cdot \boldsymbol{n}_B\right)$ indicates that the energy of particle B in the direction $\boldsymbol{n}_B$ needs to be projected into the direction $\boldsymbol{n}_A$. When two particles collide orthogonally ($\theta = 90$), their total energy is only the energy of one particle.

Figure 1(b) shows a rear-end collision, where the inertial motion of two particles A and B is in a straight line, but the preceding particle B is slower than the particle A. Two particles collide at the point H. As can be seen from Equation (7), the collision angle in the case of the rear-end collision is 0 degree. Thus, the shear stress modulus of the rear-end collision is $\tau_{Hb} = 0$, but the total energy formed by the rear-end collision is the difference between the energy of the two particles E_A and E_B,

$$E_{Ta} = E_A - E_B \cos\theta = \frac{1}{2}m_A v_A^2 - \frac{1}{2}m_B v_B^2 . \quad (10)$$

A rear-end collision creates a concentration of energy at a collision point, resulting in anomalies such as a car shattering. In the atmosphere, precipitation can form at the rear-end point when moist airflows converge.

Figure 1(c) indicates a head-on collision, where two particles A and B collide at the point H in a straight line. Since the collision angle is 180 degrees, their shear stress modulus is $\tau_{Hc} = 0$. But the total energy produced when they collide is the sum of the energies of the two particles. The total energy of the head-on collision is,

$$E_{Tb} = E_A - E_B \cos\theta = \frac{1}{2}m_A v_A^2 + \frac{1}{2}m_B v_B^2 . \quad (11)$$

Two cars can collide in the head-on way, so the energy of the collision is greater than that of the rear-end collision, and the loss is greater. The head-on convergence of moist airflows near the ground can create updrafts at the point of collision, forming clouds and causing rain. Modern artificial colliders such as the large hadron collider (LHC) since 2008 use high-energy particles to collide by using the head-on way [30] [31] [32]. The high-energy particles must be first produced at a long accelerator before the collision, so that the cost is considerable.

Figure 1(d) shows the orthogonal collision of four particles at the point H. In the macro world, those superstorms such as super typhoons or super hurricanes with their airflows collide in this way [33]. When a typhoon develops at its strongest on an open ocean, four spiral cloud-rain belt airflows appear around it and converge towards the center of the typhoon. As a result of the convergence (collision) of moist airflows, the typhoon eye (strong downdraft) in the center and the typhoon cloud-rain wall (strong updraft) around the eye are formed. Tornadoes also form quickly under the orthogonal convergence of surrounding environment airflows. Objects such as houses and trees entering the tornado are shattered and thrown into the sky.

Astronomically, black holes appear at the center of some Milky Way-like celestial systems. Four spiral nebulae belts like the Milky Way will also appear around a huge black hole. The convergence and collision of these nebulae belts towards the center of the system occurs on the accretion disk, and the center of the collision is a black hole. Black holes have an event horizon and plasma jets towards the poles [34]. The strong updrafts and sinking airflows in the center of the super typhoon are like the jets of black holes to the two poles, and the cloud-rain wall is the event horizon of the typhoon [33].

In **Figure 1(d)**, four particles form two pairs of orthogonal collisions, and their collision shear stress is,

$$\boldsymbol{\tau}_{Hd} = \left\| \left(\frac{m_A}{r_A} v_A^2 \right) \cdot \left(\frac{m_B}{r_B} v_B^2 \right) \left(\boldsymbol{n}_A \times \boldsymbol{n}_B \right) + \left(\frac{m_C}{r_C} v_C^2 \right) \cdot \left(\frac{m_D}{r_D} v_D^2 \right) \left(\boldsymbol{n}_C \times \boldsymbol{n}_D \right) \right\|. \quad (12)$$

If two adjacent particles orthogonally collide, the shear stress modulus caused by the four particles at the point H reaching the maximum is,

$$\tau_{HdM} = \left\| \left(\frac{m_A}{r_A} v_A^2 \right) \cdot \left(\frac{m_B}{r_B} v_B^2 \right) + \left(\frac{m_C}{r_C} v_C^2 \right) \cdot \left(\frac{m_D}{r_D} v_D^2 \right) \right\|. \quad (13)$$

When four particles collide orthogonally, their total energy is equivalent to the sum of the energy of two pairs of particles colliding in the head-on way.

$$E_{Td} = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 + \frac{1}{2} m_C v_C^2 + \frac{1}{2} m_D v_D^2 . \quad (14)$$

If we take the bending radius of the four colliding particles as r, their mass is m and their velocity is v, and concentrating the total energy of the collision on the area $\sigma = r^2$, the ratio α of the shear stress modulus to the total kinetic energy is,

$$\alpha = \frac{\tau_{HdM}}{E_{Td}} = mv^2 . \quad (15)$$

It indicates that the shear stress modulus is as mv^2 times as that of the total kinetic energy at the point H. Such a comparison shows that the orthogonal collision of four particles is the strongest of all collision events.

It should be noted that Equation (13) represents the two worlds (universes) before and after the orthographic collision of four particles, in which the conversion from mass to energy occurs. The conversion of mass to energy here is unidirectional, as in the thermonuclear reaction on the Sun and the explosion of an atomic bomb. The conversion of mass to energy caused by this orthogonal collision is also different from Einstein's 1905 two-way conversion between mass and energy which was based on the coordinate system transformation in special relativity [35]. The total energy represented by Equations (10), (11) and (14) is an event that occurs in the same world (universe), so the sign used in equations is "=". Collisions between particles reflect linear interactions so that their energy does not increase.

4. The Physical Nature of Electricity and Magnetism

What is the physical nature of electricity and magnetism? With the theory of combining mathematics and physics of particle interactions in Section 3, we can explore this question. We go backward to the story how a friction to generate static electricity 600 BC ago. On a macro level, artificial friction by using two different substances is the exertion of two forces (external forces) that collide. Microscopically, what happens is the cross collision between two particles as shown in **Figure 1(a)**. For example, in Equation (6) and Equation (7), the macro collision of two objects at the right-hand side produces lots of new particles at the left-hand side at the micro world or sub-atom world. All new particles follow the form of inertial motion. Orthogonal collisions of matter (particles) will form local subsystems, such as the Earth-Moon system, the system of Mars and its two moons, and the system of Jupiter and its planets and rings, which are in a large solar system. Although local subsystems are far apart, their motion characteristics are similar, which can also be called entanglement. At the macro level, multiple similar tornadoes can occur in a super typhoon system. Entanglement is a particle phenomenon in quantum mechanics [36]. At the micro level, local similarity or entanglement between particles can also occur in many new particles formed after the collision of old particles.

New particles produced by orthogonal collisions can be positively and negatively charged. In triboelectricity, the positive charge will be concentrated more on an object, and the negative charge will be more concentrated on another object. The shear stress of collision can be used in the expression of triboelectric effect,

$$\boldsymbol{\tau}_{Ha}^{+,-} = \| \left(\frac{m_A}{r_A} v_A^2 \right) \cdot \left(\frac{m_B}{r_B} v_B^2 \right) \left(\boldsymbol{n}_A \times \boldsymbol{n}_B \right). \tag{16}$$

where the corner mark "+" and "−" indicate different charges of particles. Equation (16) indicates that the collision of two objects (particles) can cause mass and energy conversion to form lots of new particles with unlike charges. If two particles collide orthogonally, more new particles of unlike charges are generated. The charge is attached to the new particle, so the new particle has mass and charge. Therefore, the physical nature of electricity is the separation of new particle charges under the action of external forces such as the frictional force.

The total number of new unlike charge particles produced by the orthogonal collision of two old particles is N, and the mass-energy relationship between the old and new particles is,

$$\frac{N}{2} m^+ c^2 + \frac{N}{2} m^- c^2 = \| \left(m_A v_A^2 \right) \cdot \left(m_B v_B^2 \right). \tag{17}$$

Here, m^+ and m^- are the positively and negatively charged masses of particles, c is the velocity of the new particle. The result from Equation (17) indicates that when the two objects rub the greater the mass (m_A, m_B) and the higher the energy ($m_A v_A^2, m_B v_B^2$) will produce the more the total number of new par-

ticles N and the faster the velocity c of the new particles.

The potential energies (electron inertia) of each positively charged particle and each negatively charged particle are, respectively,

$$E^{+} = m^{+}c^{2}, \quad E^{-} = m^{-}c^{2}. \tag{18}$$

When the difference between the airflow v_A and the airflow v_B is relatively small in the atmosphere, it is difficult to observe the separated unlike charges. In a thunderstorm when the relative motion between adjacent airflows is strong, the positive and negative charges are separated as described in Equation (18). When unlike charges are accumulated in two adjacent cloud bodies and reach a certain value, the lightning or discharge phenomenon occurs between the two adjacent cloud bodies. Two adjacent cloud bodies carry unlike charges, which form a capacitor, or a battery. The potential energy of two charged cloud bodies is equivalent to the geo-potential energy of water tower above the ground. These potential energies are the inertia of electrons.

The potential energy of electricity between cumulonimbus cloud bodies is so large that Franklin did a dangerous experiment at that time. The electrical energy (electric potential difference) or the inertia of electrons between cumulonimbus cloud bodies is still presently impossible for humans to collect and use. Therefore, people can only build dams and reservoirs, using the water level height difference (geo-potential energy) to generate electricity, and the long-distance transmission and utilization of electricity rely on wires. The geo-potential energy of water in alpine reservoirs is caused by the atmospheric circulation driven by thermal differences in the underlying surface.

Human understanding of magnetism originated from natural magnets on Earth. In the mid-20th century, parallel bands of magnetic anomalies recorded on volcanic rocks were found on both sides of the mid-ocean ridge [37] [38]. The geomagnetic anomaly bands reflect that the farther away from the mid-ocean ridge, the earlier the magnet formed. This phenomenon reveals the geological history and internal structure of the Earth. There is a movement of the outer magma fluid sphere (or layer) relative to the inner solid core in the Earth's interior. So, the Earth is an electrical generator which also forms a giant magnet. As the directionality of the rotation of the core relative to the magma layer changes, the direction of electric current and the direction of the magnetic poles also change. Mid-ocean ridges are places where earthquakes and volcanoes are unusually active. When the volcanic magma cooled to the Curie temperature, the overall electron-oriented motion in the rocks was affected by the electric current and geomagnetic direction, which was recorded by the rocks at that time. This is how natural magnets are formed.

Why can natural magnets be used as magnetic compasses to indicate direction? Magnetism reflects an overall orientation of the moving electrons formed in the rocks under the action of ambient currents at that time. The overall orientation left by the moving electrons is a storage of electrical energy, which is also the potential energy stored in the magnetic compasses. This phenomenon is

equivalent to water molecules on the ocean being driven by atmospheric circulation and falling into mountain reservoirs, stored with geo-potential energy above sea level. The electron-moving direction of the Earth's generator corresponds to the geomagnetic direction. The strength and direction of geomagnetism are denoted by $\boldsymbol{\Pi}$, while the intensity and direction of a magnetic compass or magnetic needle are denoted by $\boldsymbol{\pi}$. If putting the magnetic needle on the Earth, its final direction is the vector sum of both $\boldsymbol{\Pi}$ and $\boldsymbol{\pi}$,

$$\boldsymbol{\Pi}_{\pi} = \boldsymbol{\Pi} + \boldsymbol{\pi}. \tag{19}$$

Because $|\boldsymbol{\Pi}| > |\boldsymbol{\pi}|$, the magnetic needle is deflected, and the macro visible direction that finally takes a fixed state is $\boldsymbol{\Pi}_{\pi}$. This direction is not exactly the macro visible geomagnetic direction $\boldsymbol{\Pi}$, but it is roughly pointed the $\boldsymbol{\Pi}$. The physical nature of magnetism reflects the orderliness of the moving electrons in the material, which is also the overall orientation of the moving electrons or the inertia of electrons or the potential energy of electrons.

At this point, the physical nature of electromagnetism is clear. Electricity refers to the potential energy formed by two adjacent unlike charges, which is a new state of matter produced by the collision of objects (particles). Electricity is a way of potential energy, while magnetism is a storage of electrical energy and information caused by the overall orientation of the moving electrons in a material. Electricity and magnetism, like gravity and geo-rotational deflection, are the potential energies or inertia that objects (particles) have but they are products left by a previous orthogonal collision. A cured magnet can be divided into multiple small magnets which still have the original magnetic properties. Even a small block of magnets is also composed of many magnetized electron orientations. The feature indicates that there is no magnetic monopole, which is a longstanding problem.

Electricity, magnetism, and electromagnetic induction are natural phenomena that people can feel. The physical explanation for electricity is that the action of external forces not only forms new particles, but also separates the different charges between them. The physical explanation of magnetism is the overall directional movement of electrons in a substance caused by electric current, so magnets are solidified by the directional movement of electrons and are storage of electrical energy and information. However, there is a micro interpretation of magnetism, which holds that magnets and magnetic materials are composed of atoms or molecules with magnetic moments. Magnetic moments and magnetic domains are often mentioned in the study of magnetic materials [39] [40]. One stated that in ferromagnetic materials such as nickel and cobalt, the magnetic moments of individual atoms or molecules are arranged parallel to each other, creating magnetic domains. These aligned magnetic domains generate macro magnetic fields. A magnetic field, like a gravitational field, is something that is not explicitly stated in physics.

We believe that electrons outside the nucleus of a magnet have an overall directional motion. This directional motion of electrons stimulates the directed radiation of energy in the surrounding medium. **Figure 2** describes the effect of

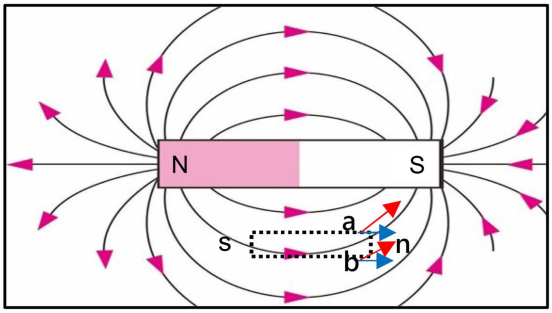

Figure 2. Schematic diagram of how a large magnet effects on small magnetic block or small iron pin (dotted wireframe area). The letters N and S indicate the poles of the large magnet, and the red arrows indicate magnetic directions of the large magnet. The letters n and s indicate the two poles of the small block, and the blue arrow indicates the magnetic direction of the small block. The letters a and b indicate two symmetrical points on a small magnetic block.

a large magnet on a small magnetic block (or small iron pin). The red arrows indicate that there are the directions and magnitudes of energy propagation of particles around the magnet, which is excited by the overall orientation of the moving electrons. The magnetic magnitude and direction vary spatially from point to point around the large magnet. Small iron pin can be magnetized immediately when it is placed near the large magnet. The two poles of the small iron pin are denoted by n and s. The magnetic intensity and direction of the small iron pin on the two points a and b are the same as π (two blue arrows), but the magnetic strengths and directions Π (two red arrows) of the large magnet there are different at the two points. According to Equation (19), an electron-oriented moment is generated between the two points a and b on the small iron pin. The electron-oriented moment here will deflect the small iron pin and even move its position, which is also different from the micro interpretation about the magnetic moments of individual atoms or molecules.

5. The Physical Principle of Electromagnetic Induction

After clarifying the physical nature of electricity and magnetism, we need to know the physical principle of electromagnetic induction. According to Faraday's law of electromagnetic induction, a changing magnetic field can induce a vortical electric field, resulting in the generation of electric currents. However, the mechanism behind the generation of vortical electric fields and their specific relationship with the magnetic field is still not fully understood. In Figure 3, a magnet is placed there. A conductor, such as a metal rod, is placed between the two poles N-S of the magnet. Both ends of the metal rod are connected to a current detector with wires. Between two magnetic poles N-S, there is an overall orientation of the moving electrons reflecting the potential energy or inertia left. The green-dotted arrow indicates the overall orientation solidified for the moving electrons. It reflects the potential quantum energy radiated between the two poles N-S of the magnet.

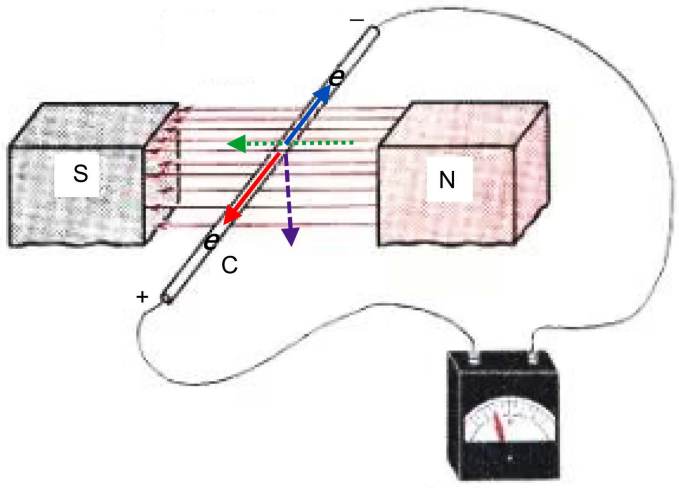

Figure 3. A simple device for electromagnetic induction. The letters N and S indicate the magnetic north and south poles of a magnetic body and the letter C indicates the metal rod. When the metal rod moves along the purple-dashed arrow and is perpendicular to the overall orientation (the green arrow) left from the movement of electrons in the magnet, the direction of the moving electrons (current) is directed along the metal rod, such as a red-solid arrow or a blue-solid arrow.

When the metal rod moves horizontally between the two poles N-S of the magnet, the pointer on the current detector is stand without swing, indicating that no current is generated. When the direction (purple-dashed arrow) of movement of the metal rod is perpendicular to the overall orientation (green-dotted arrow) between the two poles N-S of the magnet, the pointer on the current detector swings with the maximum amplitude, indicating that a current is formed. If the metal rod does not move, only the magnet is allowed to move perpendicular to the metal rod, and the current can also be detected.

How to explain the above two relative motions, by the metal rod can generate current only when the vertical movement of the metal rod relative to the magnet? The direction of moving electrons in stationary metal rods is disordered. But when the metal rod is artificially moved horizontally or vertically, the artificial moving direction for all electrons is added to the disorder movement of electrons. Only when the metal rod artificially moves vertical, the overall direction of moving electrons in the metal rod collides orthogonally with the orientation left by the moving electrons between the two poles N-S of the magnet, forming a directional motion of the new electrons perpendicular to the two original directions of moving electrons (the purple-dashed arrow and the blue-dotted arrow). The physical principle is the same as the triboelectric effect. According to Equation (6) the moving directions of new electrons are the current altering at two directions indicated by red-solid and blue-solid arrows. This is an important factor phenomenon has never been described or explained by previous laws and theories. The current altering at two directions may be indicated the physical principle of alternating current (AC) systems developed by Serbian-American inventor Tesla in 1887 [41].

In Figure 3, if the metal rod does not move, changing the strength and vertical location of the magnet can also generate the directional movement of new electrons in the metal rod, that is, generate an electric current. It indicates that the perpendicular relative movement of two overall orientations between the metal rod and the magnet produces the movement of new electrons, *i.e.*, electric current. One of two overall orientations must be caused by external forces. Thus, the action of external forces, through ordered electrons collide, generates the electrical energy.

The process from electric current to generate magnetic ions or particles continues to occur on the Earth, forming the Earth's magnetic poles and potential magnetic energy surrounding the Earth. Changes in the relative motion between the inner solid core and the outer magma layer forms changes in the intensity of the Earth's electrical generator. Changes in the position and intensity of the Earth's magnetic poles also reflect changes in the intensity of the Earth's generator. Natural magnets are permanent magnets formed by crustal activity under natural conditions, and the overall orientation left by the movement of electrons is recorded in the rocks, which is equivalent to the overall arrangement of the moving electrons. In Figure 3, once current is present on the metal rod and wire, the current changes the overall arrangement of electron orientation in the surrounding material. Once the overall arrangement of electron orientations in the surrounding material is solidified, a magnet is formed. When free electrons are around the metal rod and wire, the overall electron orientation of the surrounding material will continue to change with the intensity and direction of the current, so the magnetization of the material that changes with the intensity of the current occurs. Figure 3 depicts that Faraday's magnetic flux change induces electric current, and Ampere-Maxwell electric flux change induces magnetic intensity.

In Equation (16), the orthogonal collision of two old objects (particles) forms N new particles. The energy of each new particle is,

$$E = mc^2 \tag{20}$$

Half of N new particles have a positive charge q^+ and other half have a negative charge q^-. The generation of unlike charges is related to the product $\boldsymbol{n}_A \times \boldsymbol{n}_B$ of the two vectors. From Equations (16) and (17), the total energy of unlike charges is,

$$NE^{+,-} = \left[\left(m_A \cdot m_B\right) \cdot \left(v_A \cdot v_B\right)^2\right] \frac{q^+ \cdot q^-}{r^2}. \tag{21}$$

Thus, the energy of each charge is,

$$E^{+,-} = \left[\left(m_A \cdot m_B\right) \cdot \left(v_A \cdot v_B\right)^2\right] \Big/ N \frac{q^+ \cdot q^-}{r^2}. \tag{22}$$

The mass m and velocity c of new particle is difficulty to measure according to the uncertainty principle [42] but the charge energy $E^{+,-}$ of each electron can be detected [43]. If taking $k' = \left[\left(m_A \cdot m_B\right) \cdot \left(v_A \cdot v_B\right)^2\right] \Big/ N$, then,

$$E^{+,-} = k' \frac{q^+ \cdot q^-}{r^2}. \tag{23}$$

Obviously, Equation (23) has the same form as Coulomb's law. The physical essence expressed in Equation (23) is the energy of each charge, not an electric force acted on two charges as given by Coulomb's law. There is not an electric field and electric force between the unlike charges q^+ and q^-, but rather the inertia between charged particles, which is expressed as potential energy. Here, there are no electric field and electric force so that there are also no magnetic field and magnetic force. The expression of electric field (force) and magnetic field (force) in traditional electromagnetism is a subjective impression described by electromagnetic phenomena under Newton's worldview.

The Coulomb's constant is $k = \frac{1}{4\pi\varepsilon_0}$ and ε_0 is the vacuum permittivity. The Coulomb constant is a statistical constant. However, the letter k' in Equation (23) is not a statistical constant, because it only depends on the total number N of new particles produced by the collision of old particles. Parameter k' as well as the mass and velocity (energy) of the two original particles colliding each other are known. So far, we no longer need to use the above physical nature of electricity and magnetism, as well as the physical principles of how electric current generating magnetic intensity and *vice versa* to compare with Gauss's law for electric fields and Gauss' law for magnetic fields, as well as how Faraday's magnetic flux change to induce electric field, and how Ampère-Maxwell's law of electric flux change to induce magnetic field. These electromagnetic field laws proposed, on the one hand, is based on the experience summary and induction of observed phenomena, on the other hand, is for the convenience of mathematical description. Although Maxwell's system of electromagnetic field equations is simple and beautiful, it still does not express the physical nature of electromagnetism.

After understanding the physical nature of electricity and magnetism, we can explain the magnetization principle of ferromagnetic materials. Permanent magnets can be made by heating the material above the Curie temperature, cooling and pounding the material under ambient magnetism. The explanation is that high temperature can speed up the movement of electrons in the material, pounding the material is to let the electrons in it move, and cooling solidifies the overall orientation of the moving electrons in the material. Vibrating the material in a magnetic environment, or moving the magnet, can help magnetize the material. Therefore, the pounding, vibration, and movement of the material in a magnetic environment are all artificially caused by the relative motion of electrons in the material. The aim is to form an overall orientation of the moving electrons in the material.

The opposite is demagnetization. When the magnetic material is heated above the Curie temperature, the overall orientation left by the moving electrons in the material is disordered, and the purpose of eliminating magnetism is achieved. When a weakly magnetized material is placed in a strongly changing magnetic

environment, the magnetism of the material will be eliminated. If putting a weakly magnetized material in a reverse strong magnetic environment, the material will weaken the magnetism, or even form reverse magnetism. By pounding and hitting magnetic materials in a magnetic environment, the magnetic properties of the material can be further weakened. The principle of demagnetization is that the magnetic environment and dynamical action change the overall orientation of the moving electrons in the material.

The physical principle of electromagnetic induction is that changes in the intensity of the current change the overall orientation of the moving electrons in the surrounding material (magnetic strength), while changes in the magnetic strength in the magnetic material also change the intensity of the current in the conductor. This electromagnetic induction is a transient phenomenon, which is associated with mass-energy conversion interacted by external forces as described by Equation (22). The current in the wire is the linear propagation of the low-frequency energy of electrons, in which the conversion between kinetic energy and magnetic energy is constantly occurring, which should be described by Equation (10). Dynamically, this transformation in the form of particle energy is equivalent to a linear collision between particles in the same world, without a gain in energy. Electromagnetic waves are linear transformation and propagation of alternating high-frequency kinetic energy and magnetic energy (potential energy) of electrons. The propagation of electric currents and electromagnetic waves exhibits particle and energy fluctuations, that is, wave-particle duality.

6. Conclusions and Discussion

Human understanding how to use electricity and magnetism has gone through more than two thousand years, but the theoretically studying the electromagnetism began with Coulomb's law in 1785. Coulomb's law provided a statistical description of electricity a hundred years later than Newton's law of universal gravitation. The formula for Coulomb's law is formally the same as Newton's law of gravity. In the following hundred years, Gauss, Faraday, Ampère and others successively discovered a few statistical laws of electromagnetism through experiments. Finally, Maxwell summarized and developed these laws of his predecessors to obtain a system of equations for unified electromagnetism. These laws of electromagnetism facilitate people's production and life, but the worldview and methodology from Newtonian mechanics hinder the development of electromagnetism and affect the understanding of the nature of electromagnetic physics.

The understanding of natural science always begins with people's senses. Newton sensed the free fall of apples and the rotation of planets around the Sun, so he proposed gravitational pull between cosmic objects. Newton did not rationally recognize the nature of the gravitational force of action at a distance, so it was difficult for him to further propose innovative ideas and methods. The physical nature of Newtonian gravity is the inertia or potential energy of a small object relative to the central object in a system. Such inertia can be described by

statistical mathematics. Newton's gravitational relationship can be well applied to the inter-connected systems such as the system of Sun and its planets, the system of Jupiter and its moons and rings, and the system of Earth and its materials. Newtonian gravitational relationship cannot be used across systems such as two adjacent planets. Einstein proposed the general theory of relativity, replacing the statistical mathematical relation of Newton's gravity with geometric mathematics for about 200 years later. However, statistical coefficients still exist in the equations of general relativity, making it difficult to explain the physical nature of gravity. Describing the inertial energy of the motion of matter (particles) by force is an illusion that describes natural phenomena in sensory language.

Maxwell's unification of electricity and magnetism based on multiple laws predates Einstein's work more than a hundred years ago. Therefore, Einstein's goal after completing general relativity was to try to unify electromagnetism and gravity [44]. However, his efforts in the later decades did not meet expectations. The reason is that he shared Newton's worldview and had difficulty recognizing the new world and proposing new ideas and methods. Einstein extended from Newton's macro two-body mechanics to many-body geometry, and Maxwell was only a mathematical summary based on previous electromagnetic laws. The concepts of electric force, magnetic force, electric field, and magnetic field that appear in electromagnetism are also the result of the description of natural phenomena in sensory language. Such a statistical description of the senses, like the statistical description of gravity, does not hinder people's practical application. However, such ideas and methods hinder academic research on the physical nature of things.

The cosmic system has infinite space-time levels. The orthographic collision of two old objects or particles can create a new universe (world). Lots of new particles have appeared in the new universe, and the energy of each particle is related to the mass-energy density of the orthogonal collision of old particles, but there is no information exchange between old and new universes (worlds). These newly formed particles have inertia and can carry unlike charges. The newly generated energy density corresponds to the occurrence of extreme events or new physical state. The physical nature of electricity is the separation of particle unlike charges under the action of external forces. The physical nature of magnetism is the overall orientation of the moving electrons in a material, which is caused by electric currents. Thus, magnetic material can store potential energy and information, which origination is like the Coriolis force and gravity. The separated charge can be transported over long distances. During the propagation of electricity along the conductor, there is a directional movement of kinetic energy and potential energy (magnetic energy) of low-frequency electrons. Electromagnetic waves are the propagation of alternating kinetic energy and magnetic energy of high-frequency electrons.

The physical principle of electromagnetic induction is the new kinetic energy and magnetic energy generated by the changes of electric current and magnetic strength under the action of external force. In this process, there should be exis-

tence of orthogonal interaction between electrons within two different mediums. Changes in the intensity of the current change the overall orientation of the moving electrons in the surrounding material. Once it solidified in a material, the overall orientation forms a permanent magnet. In turn, changes in the magnetic strength (the overall orientation of the moving electrons) in a magnetic material also change the electric current in the conductor. This electromagnetic induction is a transient phenomenon, which principle is the same as that of photoelectric effect [43]. Understanding the physical nature of electricity and magnetism and understanding the physical principle of electromagnetic induction are not only the need for the development of electromagnetic theory, but also the need for human beings to better develop and utilize electromagnetic energy resources.

Under the traditional Newtonian gravitational worldview, people have a lot of understanding of electromagnetic phenomena, mainly reflecting some statistical laws of electromagnetic phenomena. In the 19th century, Maxwell summarized these statistical laws with the concepts of electromagnetic forces and fields. Since the beginning of the 20th century, the purpose of the development of quantum theory and quantum electrodynamics is to continue to advance the understanding of electron-photon interaction or photoelectric effect. For quantum theories (quantum mechanics), German theoretical physicist Planck in 1901 [45] and Einstein in 1905 [46] empirically obtained a statistical relationship between the energy of light quantum and the frequency of light, which explained phenomena such as the electron energy levels. Quantum electrodynamics incorporating quantum theory and relativity is a quantum field theory describing the interaction of electrons and photons which developed by American theoretical physicist Feynman [47] and others. But they have not studied the physical process and essence of the photoelectric effect (electron-photon interaction), so some photoelectric phenomena are still difficult to be explained by existing quantum mechanics (quantum electrodynamics). Recently, a dynamical process of orthogonal interaction between a photon and an electron to form a new state of matter in photoelectric effect experiments was studied so finding that the Planck constant is a product value of the mass, length, and velocity of a high-energy particle [43]. The dynamics of the orthogonal collision of matter (particles) can not only give the physical process and essence of the photoelectric effect, but also have great significance for the further development of quantum mechanics. It can physically explain phenomena such as wave-particle duality and quantum entanglement in the motion of high-energy particles.

In 1914, American experimental physicist Millikan's experiment [48] confirmed Einstein's quantum model. In fact, as early as 1905, Einstein was studying the relationship between mass-energy equivalence (or mass-energy equation) [49]. The title of the paper relates particle energy to inertia. However, he only can see fields under the gravitational worldview, but cannot see the existence and origination of inertial energy. In the past five decades, the standard model of particle physics has been developed [50]. However, it still contains the concept of elec-

tromagnetic force and electromagnetic field under the gravitational worldview. It now seems that under the inertial worldview, there is hope for an effective mathematical and physical dynamic description of electromagnetic phenomena. This paper confirmed the existence of wave-particle duality, uncertainty principle, quantum entanglement, dark matter, and dark energy, while it negated concepts of the magnetic monopole, the electric-magnetic fields, the electric-magnetic forces, the magnetic moments, and the magnetic domains. The standard model (the theory of everything) cannot be established on gravitational fields (forces) and electromagnetic fields (forces). Under an inertial worldview, it could be established on the unified mass-energy relationship in cosmic, macro, and micro universes [51].

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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