Scientific Research Publishing

Journal of Modern Physics, 2024, 15, 804-849
https://www.scirp.org/journal/jmp
ISSN Online: 2153-120X
ISSN Print: 2153-1196

The Essence of Gravity Is the Expansion Tendency of the Universe after the Big Bang

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How to cite this paper: Qian, W.H. (2024) The Essence of Gravity Is the Expansion Tendency of the Universe after the Big Bang. *Journal of Modern Physics*, **15**, 804-849.
https://doi.org/10.4236/jmp.2024.156036

Received: April 12, 2024
Accepted: May 19, 2024
Published: May 22, 2024

Abstract

Why cannot Newton's theory of gravitation be used to describe the motion of micro particles? This article summarizes and clarifies that Newton's theory of gravitation is subjectively a statistical description for natural phenomena, while its essence is the expansion tendency of particles in the new universe formed after the orthogonal collision (the Big Bang) of objects in the old universe. The new particles formed by the Big Bang exhibit the accelerating expansion and local convergence in the spacetime of the new universe. The force of the accelerating expansion for the new particles comes from the shear stress produced by the orthogonal collision. There is only a one-way conversion from the mass in the old universe to the energy in the new universe without any exchange of information between them. Orthogonal collision forms maximum energy density and accelerates motion of new particles. The theory that orthogonal collision produces a new universe can be used to explain the phenomena of three scales. On the cosmic scale, it can explain the Big Bang, the early celestial formation, and their movements. On the macro scale, it can explain the early Earth's surface mountain uplift and current atmospheric vortices. At the micro scale, it can explain aurora and other astronomical optical phenomena as well as the generation of new particles. The idea of orthogonal collision attempts to use shear stress and particle potential energy to find a theory of everything that can fully explain all aspects of the universe.

Keywords

Universe, Spacetime, Gravitation, Orthogonal Collision, Shear Stress, Potential Energy

1. Introduction

In 1687, Isaac Newton published his book "*Philosophiæ Naturalis Principia Mathematica*" often referred to as simply the *Principia* [1]. In this book, Newton

expounded the law of motion and the law of universal gravitation. The law of motion describes that an object with its mass will produce an accelerated motion only when it is subjected to an external force. The law of universal gravitation statistically gives a mathematical relationship, namely the interactive force between two objects equals the product of two masses and of G, a universal constant, divided by the square of the distance between them.

Since then, the statistical mathematical relationship is widely used in establishing physical laws such as the Coulomb's law in electricity [2] [3], the Planck's law in quantum theory [4], and the Einstein's law in photoelectric effect [5]. Similar as the Newton's law of universal gravitation, the statistical relationships confirmed by observations are called laws. People can conveniently use these laws in their daily lives and work. But there are two problems in these laws: one is not precise enough because constants that exist are statistical and another is not known their physical mechanisms. Therefore, the physical discipline developed with these laws of statistical relationship is not precise enough, and physical attributions are also not clear.

The law of gravitation is true at even bigger distances [6]. This was indicated by Feynman who stated that "If one cannot see gravitation acting here, he has no soul." For the gravitational law, Newton worried about why an object can act on another distant object through a vacuum without any medium to transmit action and force from one to the other [7]. He panicked at the explanation of the nature of gravity because it can be very well used in practice, but it is absurdly explained in theory.

Newton's gravitational formula gives a linear statistical relationship between two objects, which can only be used to describe a simple static universe. Two centuries later, Einstein eschewed a direct description of an unjustified gravity instead of using the idea of general relativity and the complex method of geometric mathematics [8]. As a geometric theory of gravitation, general theory of relativity is better able to describe the precession of Mercury than Newton's gravitational theory [9]. Although Einstein mathematically considered the whole universe with lots of objects in the geometric format in his theory, he was unsure about whether to introduce a cosmological constant [10]. The cosmological constant was introduced with the aim of balancing the effects of gravity to obtain a static universe [11]. Thus, the cosmological constant is a fascinating concept that concerns the evolution and structure of the universe associated with repulsion and attraction.

From Newton's gravitational law published in 1687 to Einstein's general relativity published in 1916 [9], physics describes the static relative motion relationships between matter in the universe. Inspired by the discovery of the expanding universe from Hubble's observation, the Big Bang theory was first understood and proposed by Lemaitre [12] [13]. Hubble published his famous diagram or linear relation (the Hubble law), relating the radial distance of 48 galaxies to their radial recession velocity in 1929 [14]. For this theory, the earliest and most

direct observational evidence of the universal expansion is based on the Hubble's redshift law of galaxies [15] [16]. The accelerating expansion of the universe can be thought of as a continuation of the Big Bang. Detailed measurements of the expansion rate of the universe place the Big Bang singularity at an estimated 13.8 billion years ago, which is considered the age of the universe [17] [18]. This is the largest universe in time and space scales since it forms. But a crucial question is, what was the cause or the first driving force of the Big Bang?

The above questions show that neither Newton's law of gravitation nor Einstein's general theory of relativity explain the physical nature of gravitation well [19], and the Big Bang theory does not give the first driving force and explain how matter is more rapidly gathered into galaxies and groups of galaxies [20]. Physicists hope that a better theory would entirely describe the origination, the current state, and the future development of the universe. In this article, we extend the universe from the cosmic scale to the macro and micro scales and summarize the explanation that the gravitational nature and extreme phenomena at different scales are all new physical states of matter (or new masses and energies) after the orthogonal collision of old matter. Section 2 summarizes the concept of spacetime and introduces the theory that orthogonal collision produces a new universe. Section 3 uses the orthogonal collision theory to explain the Big Bang, the gravitational field, and the motion of celestial bodies today on the cosmic scale. Section 4 uses this theory to explain the early Earth's surface mountain uplift and present-day atmospheric vortexes from tornadoes to cyclones on a macro scale. Section 5 uses this theory to explain the aurora and other optical phenomena and possible new particles in the future at the micro scale. Finally, conclusions and discussion are given in Section 6.

2. Spacetime Concept and Orthogonal Collision Theory

2.1. Spacetime Concept

We first describe a few basic concepts such as the universe, spacetime, and gravity. Generally, time is the continued sequence of existence and event that occurs in an apparently irreversible succession from the past, through the present, and into the future. Thus, time is the measurement of when events occur within the universe. Space is a three-dimensional continuum geometry of the universe containing positions, shapes, distances, and directions. In classical physics, space is often conceived in three linear dimensions, while spacetime is a mathematical model that fuses the three dimensions of space and the one dimension of time into a single four-dimensional continuum. Spacetime diagrams are useful in visualizing and understanding relativistic effects of matter motion such as how different observers perceive where and when events occur. Until the turn of the 20th century, the assumption had been that the three-dimensional space was distinct from time. However, space and time took on new meanings with the Lorentz transformation and special theory of relativity [21]. In 1908, Minkowski presented a geometric interpretation of special relativity that fused the three spa-

tial dimensions with time into a special four-dimensional continuum [22]. This interpretation proved vital to the general theory of relativity, wherein spacetime is curved by mass and energy [9].

Currently, the universe is considered as all of space and time and their contents of matter motion [23]. It comprises all of existence, any fundamental interaction, physical process and physical constant, and therefore all forms of energy and matter, and structures they form, from sub-atomic particles to entire galaxies. Space and time, according to the prevailing cosmological theory of the Big Bang, emerged together 13.787 ± 0.020 billion years ago and the universe has been expanding ever since [18].

The concept of the universe in ancient Chinese philosophy encompasses all of space and time, and the content describes the evolution of all things. The ancient Chinese referred the universe as the combination of time and space, without specially mentioning the first driving force. From ancient times and modern times, the universe or spacetime mentioned above is cosmic scale. Although the multi-universe concept has also been proposed in modern times [24] [25], it requires a unified theory at the cosmic, macro, and micro scales.

Here we need to expand the universe in two directions: one is to refine from the cosmic scale to the macro and micro scales, and the other is to give life to the universe. Life is not only about time and space, but also about indispensable contents such as mass and energy during a life process. Therefore, the universe is spacetime, a complete life process. Life goes through its time from birth to death. In the process of life, there are its formed position, spatial shape, development direction, material composition, and energy changes, even electric charges. Space is formed wherever matter and energy go.

Above, our descriptions of the universe, spacetime, and life are all conceptual. In the following, we will describe the living universe or spacetime in mathematical form. We examine the interaction between particles (or objects) and the interaction between celestial bodies, particle beams or groups of celestial bodies, even between air masses (or fluid blocks).

To describe multiscale universes, both the particles and objects in this article appear at low speeds. For the mass m of a particle or an object, an external force acts on it and changes its inertial speed v in time t,

$$\boldsymbol{F}_a = m\boldsymbol{a} = m\,\mathrm{d}v/\mathrm{d}t\cdot\boldsymbol{k} = (1/v)\cdot\mathrm{d}\left(mv^2/2\right)\Big/\mathrm{d}t\cdot\boldsymbol{k}\,. \tag{1}$$

where, $\boldsymbol{k}$ is the direction in which the inertial speed v varies over time t. Equation (1) is the mathematical expression of Newton's second law described how the external force $\boldsymbol{F}_a$ acting on the motion of a particle or an object. The external force directly acts on the mass m generating acceleration $\boldsymbol{a} = \mathrm{d}v/\mathrm{d}t\cdot\boldsymbol{k}$ without any statistical constant. The inertial speed v or kinetic energy ($E = mv^2/2$) of the particle or object varies with time interval $\mathrm{d}t$. But in the same universe, the mass m of a particle or an object does not change with time. For a massive object, a greater external force $\boldsymbol{F}_a$ is required to change its speed or kinetic energy. In Equation (1), mass and time are two independent scalars.

For the mass m of a particle or an object, another external force acting on it and changes its inertial speed $v\boldsymbol{n}$ in space r is,

$$\boldsymbol{F}_p = m\left(v^2/r\right)\boldsymbol{n}. \tag{2}$$

where, $\boldsymbol{n}$ is the direction in which the inertial speed v varies with space r, *i.e.*, the direction of centripetal acceleration $\boldsymbol{p} = \left(v^2/r\right)\boldsymbol{n}$. Equation (2) is the centripetal force $\boldsymbol{F}_p$ of the object moving on a curve, which is needed for the elliptical revolution of the Earth around the Sun and the elliptical revolution of the Moon around the Earth. For a massive object, a greater centripetal force is required to change the moving direction. The mass does not vary depending on the location in the space. In Equation (2), mass and space are two independent scalars.

For an object of a mass m on the Earth freely falling with an acceleration $\boldsymbol{g}$ perpendicular to the surface of the Earth, the Earth's gravity is traditionally,

$$\boldsymbol{F}_g = m\boldsymbol{g}. \tag{3}$$

where, $\boldsymbol{g}$ is a net acceleration that is imparted to objects due to the combined effect of gravitational acceleration $\boldsymbol{g}_m$ indicated to the center of Earth (from mass distribution within Earth) and the centrifugal acceleration $\boldsymbol{g}_c$ (from the Earth's rotation),

$$\boldsymbol{g}_c = \left(v^2/r\right)\boldsymbol{e}. \tag{4}$$

where, v is the tangential speed of an object on the surface of the Earth, r is the distance from the object on the surface to the rotation axis of the Earth, $\boldsymbol{e}$ is perpendicular to the direction of the Earth's axis. Thus, $\boldsymbol{g} = \boldsymbol{g}_m + \boldsymbol{g}_c$ and $\boldsymbol{g}_m \gg \boldsymbol{g}_c$. For the object with its mass m at the equatorial surface its gravity is,

$$\boldsymbol{F}_{gE} = m\boldsymbol{g}_m - m\boldsymbol{g}_c. \tag{5}$$

While at the points of two poles, their gravity is,

$$\boldsymbol{F}_{gp} = m\boldsymbol{g}_m. \tag{6}$$

Thus, the Earth's gravity is a function of latitude φ,

$$\boldsymbol{F}_{g\varphi} = m\boldsymbol{g}_m - m\boldsymbol{g}_c\cos\varphi. \tag{7}$$

Equation (7) shows that the gravity is greater at the points of two poles than that along the equatorial zone. Gravity also determines the shape of the Earth so that the radius of the equatorial zone is greater than the radius of the polar points. All rotating moons, planets, and stars have a similar oblate spherical distribution. If the rotation speed of a celestial body is greater, the flatter its spatial sphere will be. In celestial motion, mass centripetal (centrifugal) force must be considered. Later, we will give that the centrifugal force $\boldsymbol{F}_{gc} = m\boldsymbol{g}_c$ associated with the Earth's rotation is a fictitious force.

If there are two objects in space that are far apart, Newton's gravitational law is expressed as,

$$\boldsymbol{F}_g = GmM/r^2 \cdot \boldsymbol{k}. \tag{8}$$

where, m is the mass of small object, M is the mass of large object, G is a statistical or universal constant, r is the distance between two objects, $\boldsymbol{k}$ should be the direction from small object to large object or opposite. Obviously, Equation (8) is a simple statistical relation without knowing physical essence. As questioned by Feynman [6], "why can we use mathematics to describe nature without a mechanism behind it?"

If there is no rotation and revolution between the two objects, the following relationship can be obtained from Equation (3) and Equation (8),

$$\boldsymbol{g} = \frac{GM}{r^2} \cdot \boldsymbol{k} . \tag{9}$$

It can be found that the gravitational acceleration of a small object relative to a large object is directly proportional to the mass of the large object and inversely proportional to the distance square between them. It is a fact that in the universe, small objects tend to accelerate towards large objects. However, the origin of this acceleration remains a mystery. This is a phenomenon that needs to be explained by a new theory. Later, we will give that the mass force $\boldsymbol{F}_{gm} = m\boldsymbol{g}_m$ and the mass centripetal force $\boldsymbol{F}_{gc} = m\boldsymbol{g}_c$ are the two basic forces for all matter motion in the universe. The question one needs to answer is, what dynamical mechanism is responsible for these two forces?

2.2. Orthogonal Collision Theory

In the above expressions, Equation (1) contains time and Equation (2) contains space so that time and space are separated. For a moving object, such a separation of time and space is a set of mathematical expressions, not a set of physical expressions. In Equation (1), the time of this universe is mathematically expressed by dt. In Equation (2), the space of this universe is mathematically expressed by r. Time dt and space r need physical events or contents to form the universe and express the spacetime. The inertial speed v of all objects or particles in the universe is constantly changing, *i.e.*, accelerating expansion dv/dt with time and changing with the curve v^2/r of space. Thus, a question to ask is how did the universe come to be? Or what was the initial state of the universe [26]?

All the independent objects in the universe, such as celestial bodies, the Sun, planets, satellites, and particles, are moving in a curve and changing in a speed. The change in the inertial speed namely the total acceleration of an object per unit mass has the sum of the above two components dv/dt and v^2/r. Thus, the instantaneous curvilinear motion of each celestial object or particle has a radius of motion and a mass centripetal force, as in Equation (2). In the universe of accelerating expansion, two objects with their mass inertial forces such as from the force in Equation (1) cannot collide each other. The event of collision can only occur between two objects with mass centripetal forces such as shown by Equation (2). If two celestial objects or particles with their mass centripetal forces collide at a point H, then the shear stress of collision is formed,

$$\boldsymbol{\tau}_H = \boldsymbol{F}_A \times \boldsymbol{F}_B = \left(\frac{m_A}{r} v_A^2\right) \cdot \left(\frac{m_B}{r} v_B^2\right) \cdot \left(\boldsymbol{n}_A \times \boldsymbol{n}_B\right). \tag{10}$$

where, the centripetal force of a celestial object or particle with mass m_A (or m_B), speed v_A (or v_B) and direction $\boldsymbol{n}_A$ (or $\boldsymbol{n}_B$) is $\boldsymbol{F}_A$ (or $\boldsymbol{F}_B$). The directions of the shear stress $\boldsymbol{\tau}_H$ are perpendicular to the plane ($\boldsymbol{n}_A \times \boldsymbol{n}_B$) formed by the collision of two mass centripetal forces. The term $\boldsymbol{\tau}_H$ is the new formed forces.

Two objects or particles may be a rear-end collision with $\theta = 0^\circ$, or head-on (face-to-face) collision with $\theta = 180^\circ$, or right-angle collision with $\theta = 90^\circ$. Two celestial bodies or particles are more generally colliding at any angle. At the point *H*, a shear stress modulus formed by the collision of two particles at an arbitrary angle θ is [27],

$$\tau_H = \left(\frac{m_A}{r_A} v_A^2\right) \cdot \left(\frac{m_B}{r_B} v_B^2\right) \sin\theta. \tag{11}$$

The shear stress modulus in rear-end collision and head-on collision is zero, while the shear stress modulus formed by an orthogonal (right-angle) collision is the maximum. The shear stress modulus of collision at other angles is magnitude between zero and the maximum. When two celestial bodies or particles collide orthogonally with $\theta = 90^\circ$, $\sin\theta = 1$, so that the maximum shear stress modulus is,

$$\tau_{HM} = 4\left(\frac{m_A}{2} v_A^2\right) \Big/ r_A \cdot \left(\frac{m_B}{2} v_B^2 \Big/ r_B\right). \tag{12}$$

where, the term $E_A = \frac{m_A}{2} v_A^2$ is the kinetic energy of a celestial body or particle *A* (or *B*). Then the term $\left(\frac{m_A}{2} v_A^2\right) \Big/ r_A$ is the kinetic energy line density of the celestial body or particle *A* (or *B*) relative to its rotating central point. They are the potential energy of matter relative to their tendency center. If we stand on the gravitational worldview, the potential energy is the gravitational energy or the gravitational field. If two celestial bodies or particles are taken with the same mass $\tilde{m} = m_A = m_B$, the same speed $\tilde{v} = v_A = v_B$, and the same radius $\tilde{r} = r_A = r_B$, the kinetic energy is also the same, *i.e.*,

$$\tilde{E} = \tilde{E}_A = \tilde{E}_B = 1/2 \cdot \tilde{m}\tilde{v}^2. \tag{13}$$

In this case, taking $\tilde{r} = 1$ as the unit length of the new state of matter, the energy density per unit area $\tilde{r}^2$ is,

$$\tau_{HM} = 4\tilde{E}^2. \tag{14}$$

The new state of matter with the high energy density concentrates on a singularity of orthogonal collision. New material and energy properties after the orthogonal collision are unrelated to the material and energy properties of the old universe before the orthogonal collision. The new particles no longer move around the old cosmic centrosome. In Equation (14), the term $4\tilde{E}^2$ on the

right-hand side is the new energy density formed after the orthogonal collision of two old celestial bodies or particles, while the term τ_{HM} on the left-hand side is the energy of all new particles in the new physical state. The two spacetimes or universes before and after the orthogonal collision are completely different.

In Equation (14), it is assumed that there are N new particles in the new physical state of matter, each with a mass m and a speed c (it is not the speed of light). The total energy of N particles in the new universe is equivalent to the energy density generated by the collision,

$$4\tilde{E}^2 => Nmc^2. \tag{15}$$

where, the symbol "=>" indicates that the mass and energy of objects in the old universe are unidirectionally converted into the total mass and energy of N new particles in the new universe after the orthogonal collision. Apparently, there is an equivalence relationship,

$$E = mc^2. \tag{16}$$

where, $E = 4\tilde{E}^2/N$ expresses the energy of each new particle among total N new particles. Equation (16) expresses the relationship of the energy E of each new particle in the new universe with its mass m and speed c. The energy E, mass m and speed c in the new universe is different from the energy $\tilde{E}$, mass $\tilde{m}$ and speed $\tilde{v}$ in the old universe. The form of Equation (16) is same as the mass-energy formula of Einstein [28]. However, the physical meaning of Equation (16) is different from the relationship of mass-energy equivalence which was based on the special theory of relativity or relativistic mathematical transformations of two coordinate systems [29]. Thereafter, the term mc^2 or mv^2 or $\tilde{m}\tilde{v}^2$ is referred as mass-energy.

Between the new and old universes, the conversion relationship of mass-energy is physically like,

$$\tilde{m}_A\tilde{v}_A^2 \cdot \tilde{m}_B\tilde{v}_B^2 => Nmc^2. \tag{17}$$

Equation (17) describes the conversion of mass-energy from an old universe (left) to a new universe (right) through the orthogonal collision. Equation (15) or Equation (17) shows that there is only a one-way conversion from the mass in the old universe to the energy in the new universe, but there is no information exchange between them. Obviously, in Equation (17), $m \ll \tilde{m}_A$ ($\tilde{m}_B$) and $c \gg \tilde{v}_A$ ($\tilde{v}_B$). The above proposed theory diverges significantly from established physics principles, such as the conservation of mass/energy and the exchange of information between universes.

In the universe and in nature, there are many opportunities for collisions between objects or particles. The chances of an orthogonal collision of objects or particles are rare. Therefore, the orthogonal collision of objects or particles corresponds to an extreme event, because the energy density formed by the orthogonal collision is the largest. Crucially, the result of the orthogonal collision between objects or particles is the formation of a new physical state of matter. Two different spacetimes or universes exist before and after the collision. From Equa-

tion (10) to Equation (17), we mathematically and physically describe the formation of a new universe or a new spacetime. This theory of orthogonal collision can be used to explain all natural phenomena in our universe and multi-level universes.

The shear stress and its modulus formed by orthogonal collision are often applied to the dynamic description of the interaction between two rigid bodies or two particles. In this article, we apply the orthogonal collision theory not only to the interaction between cosmic-scale objects and micro-scale particles, but also to the interaction between macro-scale fluids. In fact, the Earth's magmatic fluid, oceanic fluid, and atmospheric fluid are also made up of particles at the molecular scale. These fluids can be collectively referred to as a continuum or medium that is made up by particles. Waves are formed in the surface layer of the ocean and in the interior layer of the atmosphere, but they are respectively made up of different seawater particles and air particles. The solar wind radiated by the solar activity, ions in the Earth's upper atmosphere, and ubiquitous electromagnetic waves can also be seen as a continuum of particles. Therefore, the orthogonal collision theory can be applied to the interaction of different units such as individual particles, particle beams, air streams, fluid clusters, and solid groups. Each of their units is identical in terms of properties (e.g., charge and state), speed and moving direction, while different units can be distinguished from each other. For convenience, we use the characteristics such as speed or charge of a particle to represent the overall characteristics of a unit. Similarly, we use the interaction of two particles to represent the interaction of two units. Examples in this article will show that the orthogonal collision theory of Equation (10) and Equation (11) can be applied to the interaction and mass-energy conversion between groups of particles, solids, fluids, and gases such as continental plates, magmatic masses, and air masses. Thus, words "collision" ("collide") and "convergence" ("converge") are often used in the interaction or relative motion between units or groups. The result of many unit collisions or convergences is collapse or contraction, and the opposite is expansion or inflation [30].

3. Cosmic Scale Universe

3.1. The Big Bang

The universe should contain three scales of matter. On the micro scale, particles such as molecules even smaller ones (atoms and electrons) can only be found from a microscope. On the macro scale, bodies such as stones or systems such as tornadoes can be seen with the naked eye. On the cosmic scale, objects such as planets, stars and galaxies can only be observed by telescopes. At present, there are two theories that describe the movement of matter in the universe. One is the general theory of relativity, which describes the motion of matter (planets, stars, galaxies, clusters of galaxies etc.) on the cosmic scale. The other is quantum mechanics, which describes the motion of particles (atoms, electrons, and photons) at the micro scale. Currently, physics is looking for a widely accepted theory of

quantum gravity (or quantum theory of gravitation) [6], which is an attempt to find a theory of everything that can fully explain all aspects of the universe [31]. There have been theoretical frameworks such as the Big Bang and various superstring theories that have attempted to explain the formation and current structure of the universe, but none of them have reached the point where they can explain all the scale phenomena in the universe.

The Big Bang is a physical theory that describes how the universe expanded from an initial state or a primordial singularity of high density and temperature [32]. The Big Bang theory was inspired by the discovery of the expanding universe and proposed by Lemaître [12] [14]. The Big Bang theory is based on Einstein's general theory of relativity and the cosmological principle. According to the relativity, matter and energy are capable of distorting spacetime to form a gravitational field. The relativity is also called the Einstein's law of gravitation [6]. The cosmological principle states that on large scale or on cosmic scale the universe is homogeneous and isotropic, appearing the same in all directions regardless of location [33] [34].

Various cosmological models of the Big Bang explain the evolution of the observable universe from the earliest known periods through its subsequent large-scale form [35] [36]. Measurements of the redshifts of supernovae indicate that the expansion of the universe is accelerating [37]. There remain aspects of the observed universe are not yet adequately explained by the Big Bang models. The first is what was the origin of primordial singularity, or the driving force behind the Big Bang? The second is what is the physical nature of the gravitational field? The third is how to understand the earliest era and structure of the universe such as the generation of stars in the universe?

According to the Big Bang model or theory, it is difficult for people to find any information before the Big Bang. In other word from Equation (17), there is no exchange of information between the old and new universes. Equation (10) tells us that the current universe on a cosmic scale is from an orthogonal collision of matter. When objects in the old universe collide orthogonally, N new particles are formed in the new universe. These N new particles are initially concentrated in a small singularity with a high energy density (high pressure and temperature) as indicated by Equation (14).

According to Equation (10), the moving direction of the new particles in the new universe is perpendicular to the orthogonal collision plane of the old particles in the old universe. In the two spaces on both sides of this plane, new particles in number are equal. Due to the presence of such a high energy density (high pressure and temperature), N new particles start to acceleratingly expand outward from the singularity of orthogonal collision. After starting from the Big Bang, the current universe is situated at the state of an overall homogeneous and isotropic acceleration of expansion. From that singularity, each new particle has its moving direction and acceleration, which is driven by the shear stress collided by the old objects. Therefore, the shear stress formed by the orthogonal

collision of matter in the old universe is the first driving force for the formation and expansion of the new universe. The orthogonal collision of matter in the old universe is the Big Bang.

One remaining question is, where did the matter that collided orthogonally in the old universe come from? This is a question of Pre-Big Bang [30]. We can only answer that the matter in the old universe was formed by the orthogonal collision of matter in the universe before them. All we can observe are the movement of matter in the current universe and their expanding tendency. Equation (17) tells us that it is impossible to know any cosmic information of multiple levels before the old universe. The current spacetime is completely different from the spacetimes of the previous multi-level universes. The current universe or spacetime is still expanding, which can be described in terms of four dimensions. If the old universe can also be described in terms of four dimensions, it is necessary to use mathematical methods to describe both the old and new universes in eight dimensions. Thus, the mathematical description of three-level universes needs twelve dimensions. The properties and accelerations of particles are different in different level universes. The mathematical forms of multidimensional complexity that various string theories may give are attempts to express multiple level universes. However, the physical information from an old universe to a new universe has been destroyed by the extreme event of orthogonal collision. Therefore, complex string theories, even with mathematical solutions, are difficult to verify with physical information. We don't yet fully understand the information of the current universe. However, how many levels of universes are not known.

3.2. Physical Nature of the Gravitational Field

Newton found the reason of the natural phenomenon for an apple falling freely as the gravitational effect. This invisible force from the Earth pulls the apple down, just as the Earth pulls the Moon, causing the Moon to move around the Earth, and like the Moon pulling the sea water to form a tide. This story is precisely a subjective description of objective phenomena. Subjectively describing these objective phenomena in terms of the gravitational relation of statistical mathematics was something Newton doubted, and Einstein avoided. What is the physical nature behind these objective phenomena? For such a simple law, what is about the machinery of it? Newton was satisfied to find what it did without getting into the machinery of it [6].

From Equation (10) and Equation (17), the Big Bang produced N new particles. The shear stress of each new particle is $\boldsymbol{\tau}_{1/N}$, which contains the mass accelerating force $\boldsymbol{F}_a$ of the new particle and the mass centripetal force $\boldsymbol{F}_p$ of the curvilinear motion,

$$\boldsymbol{\tau}_{1/N} = \boldsymbol{F}_a + \boldsymbol{F}_p = m\mathrm{d}v/\mathrm{d}t \cdot \boldsymbol{k} + m\left(v^2/r\right)\boldsymbol{n}. \tag{18}$$

The shear stress of each new particle determines its past trajectory, current location, and future motion trend. Among them, a component $\boldsymbol{F}_a = m\boldsymbol{a} = m\mathrm{d}v/\mathrm{d}t \cdot \boldsymbol{k}$

of the shear stress determines the accelerating expansion of the new particle relative to the initial singularity. Another component $\boldsymbol{F}_p = m\left(v^2/r\right)\boldsymbol{n}$ determines the curvilinear motion of new particle in space. Therefore, each new particle starts the spiral motion of acceleration from the singularity.

In the singularity of the Big Bang, there is a group of new particles that accelerate towards the central place of the Earth. Among them, some new particles arrived early and became the central core of the Earth. The kinetic energy of the collision of these particles is converted into internal energy (thermal energy), which increases the temperature of the Earth's core. Later, the kinetic energy of other particles collided the core was also converted into heat energy. When the Earth was formed in the early days, the temperature was constantly rising, and it finally took the form of molten magmatic ball. All the particles that come together form a dominant plane of rotation under the action of the centripetal force as indicated in Equation (18). The particles that arrived at the Earth in the early and late stages respectively constitute the solid core of the Earth and the outer layer of high-temperature magmatic fluids. Relative motion is formed by angular velocity differences between different layers and between different latitude zones. The angular momentum exchange between different layers is the fundamental driving mechanism of continental drift on Earth in the later period.

After the collision of all the particles that reach the Earth, the chemical composition of the magmatic fluid at high temperatures and pressures changes. At the same time, some heavy elements converge with a greater acceleration towards the center of the Earth, and they converge into the Earth's interior. Those light elements combined small accelerations of convergence form the outer crust, oceans, and atmosphere. Lighter elements still have the most primitive mass acceleration and mass centripetal force as indicated by Equation (18). But their total force is balanced by the outward density pressure gradient force. The balance of such density stratification and the convergence force towards the center of the Earth forms different layers of density such as the core, magmatic layer, lithosphere, hydrosphere, and atmosphere. At this point, we will realize that Equation (5) and Equation (18) describe the same particle on Earth. Equation (5) argues that particles on the ground are subject to mass gravity $m\boldsymbol{g}_m$ and mass centrifugal force $-m\boldsymbol{g}_c$. Equation (18) argues that particles on the ground have the most primitive mass acceleration force $\boldsymbol{F}_a = m\mathrm{d}v/\mathrm{d}t\cdot\boldsymbol{k}$ and the mass centripetal force $\boldsymbol{F}_p = m\left(v^2/r\right)\boldsymbol{n}$. The mass centrifugal force is an imaginary force. Its essence is derived from the mass centripetal force formed after the Big Bang. Thus, Equation (5) is an expression under the gravitational worldview, while Equation (18) is an expression under the inertial worldview.

On the Earth's surface, for an object in free fall, Newton explained that there is a force acting at it from the Earth's center. Therefore, gravity is a subjective explanation of objective phenomena from a passive worldview or the gravitational worldview. On the other hand, an active worldview or the inertial worldview believes that free fall of objects is its accelerating motion continuously after the Big Bang. The mass acceleration force and the mass centripetal force of the surface

matter under the active worldview form a potential energy produced by the Big Bang. By Equation (18), a rocket that is stationary relative to the ground has a natural converging force (originating after the Big Bang) towards the center of the Earth. For the rocket to accelerate away from the Earth, the driving force formed by the ignition of the rocket must be greater than the converging force that makes up the rocket to the center of the Earth. The essence of gravity is the shear stress that formed after the Big Bang. The so-called gravitational energy storage is the work done to overcome the shear stress.

In the aftermath of the Big Bang, there is another small group of new particles in the vicinity of the target Earth's location, whose destination is slightly deviated from the Earth's position. These new particles eventually formed the Moon, a satellite near the Earth. Among them, the particles that arrive first to the position of the Moon form the inner core, and the particles that arrive last form the outer shell of the Moon. In fact, some new particles gathered on the way to the Moon and became meteorites to hit the Moon. Therefore, there are many traces of meteorite impact left on the surface of the Moon. During the early days of Moon's life, there was relative motion between the lunar core and the out magmatic layer. Therefore, there was remanent magnetization of lunar soils [38]. The centripetal force $\boldsymbol{F}_p = m\left(v^2/r\right)\boldsymbol{n}$ at which all the particles of the target Moon deviate from the common center of both the Earth and the Moon forms the motion of the Moon around the Earth. The lunar particles originated from the Big Bang determine the material composition, mass, volume, and the converging force of the Moon. The converging mass acceleration determines the measurable gravitational pull on the Moon.

The elliptical motion of planets relative to the Sun, the elliptical motion of the Moon relative to the Earth, the elliptical energy distribution of the Earth's oceanic fluids relative to the Earth's axis and their variations are all manifestations of inertial motion, which are legacy products from the Big Bang. Thus, the inertia tidal theory shows that the most obvious semidiurnal tide and the half-monthly tide in oceans are oval distributions of fluid inertial motion energy relative to the Earth's axis [39]. The tidal phenomena in Earth's fluids have nothing to do with gravity, but rather are an energetic manifestation of the inertial motion of fluids on a planetary scale.

All the planets and moons in the solar system, as well as the asteroid belt, were formed like the Earth and the Moon. The celestial objects in the Kuiper Belt and those comets are confluences of new particles from the initial Big Bang. Their mass acceleration force $\boldsymbol{F}_a$ and the mass centripetal force $\boldsymbol{F}_p$ of curvilinear motion determine their trajectory of motion. Therefore, tidal phenomena in the fluids of planets and satellites, the revolution of the Moon around the Earth, and the orbit of the planets around the Sun are not the result of gravitational interaction.

3.3. The First Generation of Stars

According to orthogonal collision theory, the first series of stars were created

during the accelerating expansion of the universe after the Big Bang. Although it is difficult to determine the exact age of star formation, the principle of formation is clear. We start to describe the nearest star to us, the Sun. After the Big Bang, a large group of new particles moved towards the central position of the Sun. The particles that arrive earlier form the central core of the Sun. Other particles that arrive separately in the later stages form the outer material composition of the Sun. The speed of the particles reaching the position of the Sun is great and the energy is also great. These sequential particles collide, producing nuclear fusion, rising temperature, and forming different rotational velocities of inner and outer layers. They reached the position of the Sun have an overall plane of rotation, forming the Sun's rotational equator. The centripetal rotating speed of particles at the equator is the greatest, so the Sun is also a flat star. There are relative motions in different vertical layers and different latitude zones. These relative motions are the source of particle collisions. Nuclear fusion is constantly produced during these collisions. As a result, large-scale relative motion and small-scale vortex motion on the Sun continuously produce nuclear fusion, which forms total solar radiation. Violent collisions of vortex particles in localized areas produce the so-called sunspot activity, which releases anomalous radiation energy into space. Similarly, stars are formed by the convergence of different groups of new particles after the Big Bang. All particles have enormous potential energies relative to their convergence centers. At the same time, the collision when they converge creates nuclear fusion, which releases more energy. The relative motions and collisions of particles inside these stars are still undergoing nuclear fusion, making them as luminous stellar objects.

The Milky Way galaxy is a rotating celestial body composed of many Sun-like stars. All the stars in the Milky Way galaxy are emitting light like the Sun. After the Big Bang, a group of more new particles converged towards the center of the Milky Way galaxy. In this general convergence process, there are many stellar particle clusters, which converge in advance to form luminous stars. But these formed stars do not stop, and they spirally continue towards the center of the Milky Way galaxy. In the Milky Way galaxy, there are multiple spiral arms converging towards the center. The Sun is on one of the spiral arms. The Sun's convergence path towards the center of the Milky Way galaxy is affected by the two forces in Equation (18).

After the Big Bang, the formation of the Sun and other stars is similarly to the current shape of the Milky Way galaxy, with lots of particles accelerating towards their center on a flat of rotating plane, also known as an accretion disk. Eventually, all the particles are concentrated in the position to form the Sun. The Milky Way galaxy is going through an intermediate process as like when the Sun formed. Finally, lots of stars converge along the spiral arms to the center of the Milky Way galaxy. The center of the Milky Way galaxy is like a black hole converging lots of stars. However, this process does not come from the gravitational pull at the center of the Milky Way galaxy, but from the particle shear stress in-

dicated by Equation (10) after the Big Bang. After lots of stars converge along the spiral arms to the center of the Milky Way galaxy, there are still some celestial bodies left on the rotation plane of accretion disk, which orbit around the center of the Milky Way galaxy like the asteroid belt in the solar system. They didn't merge into the center of the galaxy because the effect of the mass centripetal force $\boldsymbol{F}_p$ as shown in Equation (18).

3.4. Mercury Precession

Mercury is the inner most one of planets in the solar system. According to Newton's theory, Mercury's orbit should be a closed ellipse, consistent with the results proposed at the beginning of 1600s by Kepler. In fact, Mercury orbits its trajectory in an ellipse and its long axis also rotates slightly in space. Perihelion precession is a gradual shift of the point of the closest approach of a planet to the Sun and around the Sun. In 1859, French mathematician U. Le Verrier first reported Mercury's perihelion anomalous precession, finding that there was a discrepancy by 38'' arcseconds per tropical century between the perihelion precession observations and Newton's law calculations [40]. In the half-century since, a variety of theories have been proposed to explain this discrepancy. In 1907, Einstein began to study the theory of gravity, hoping to find a way to calculate the perihelion precession of Mercury. In 1915, Einstein proposed his general theory of relativity which has been experimentally verified with great accuracy for samples of various materials and planets [41] [42]. Einstein's theory predicted correct advance of the perihelion of Mercury [9]. This success prediction shows that general relativity is an excellent expression and alternative theory of gravity so that Einstein considered it the most critical test of his theory.

The perihelion precession of Mercury is already an astronomically accepted fact. There are two different worldviews on the movement of planets in the solar system relative to their centrosome. The gravitational worldview holds that the planets are passively moving around the centrosome in the gravitational field of the Sun, while the inertial worldview holds that the planets are actively moving around the centrosome under inertial acceleration. General relativity can phenomenologically or geometrically describe the law of Mercury's perihelion precession, but it does not detailly know what causes the inertial motion of matter (particles) in the solar system.

If we consider that only two objects m_A and m_B with their speeds v_A and v_B as well as their distance r were produced after the Big Bang. Their energy density changes with the expansion ($\frac{\mathrm{d}r}{\mathrm{d}t} \neq 0$) of the space formed by the two objects. From Equation (12), we have,

$$\tau = \left(m_A v_A^2\right) \cdot \left(m_B v_B^2\right) \Big/ r^2 . \tag{19}$$

Any system has its common center of motion. The system of Earth and Moon has their common center of motion. The system of the Sun and Mercury also has a common center of motion if only considering two objects in the universe. If

the mass-energy of the Sun is $m_A v_A^2$, the ratio of the total energy density τ of the system to the mass-energy $m_A v_A^2$ of the Sun is $K = \tau / \left(m_A v_A^2 \right)$. Thus,

$$Kr^2 = mv^2 . \tag{20}$$

In Equation (20), the term $mv^2 = m_B v_B^2$ is Mercury's mass-energy. For the system of the Sun and Mercury, their common center of motion is approximately at the center of the Sun. Thus, r is the radius of Mercury's revolution relative to the Sun. If K and m are not change with time ($\mathrm{d}K/\mathrm{d}t = 0$), we have [43],

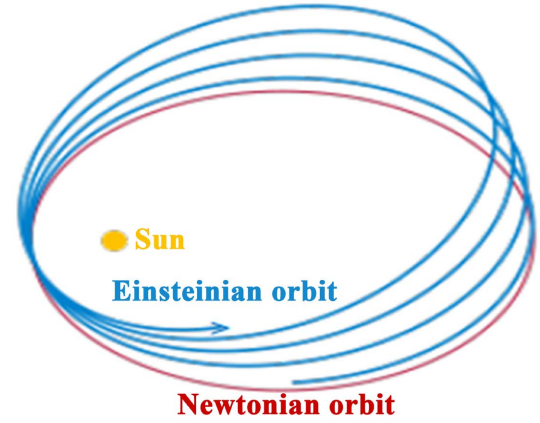
$$Kr\frac{\mathrm{d}r}{\mathrm{d}t} = mv\frac{\mathrm{d}v}{\mathrm{d}t} . \tag{21}$$

Clearly, the trajectory formed by the change of two variables v and r with time t is an ellipse. Equation (21) shows that Mercury has the shortest elliptic radius and the slowest velocity when it is at perihelion. When Mercury is at aphelion, it has the longest ellipse radius and the fastest velocity. When Mercury is at perihelion and aphelion, changes in radius length and speed with time are zero, so that perihelion and aphelion are two special locations on the ellipse. As Mercury moves from perihelion to aphelion, the radius r increases with time t, namely $\mathrm{d}r/\mathrm{d}t > 0$. The closer to the aphelion, the larger $r\mathrm{d}r/\mathrm{d}t$ and the faster speed v and the larger $v\mathrm{d}v/\mathrm{d}t$ are. Mercury returns from aphelion to perihelion in the opposite tendency. Mercury's path is an elliptical orbit under Newtonian gravity (**Figure 1(a)**). Under this limit, Mercury orbits to meet the Kepler's second law, sweeping out the equal area within the ellipse in the equal time interval.

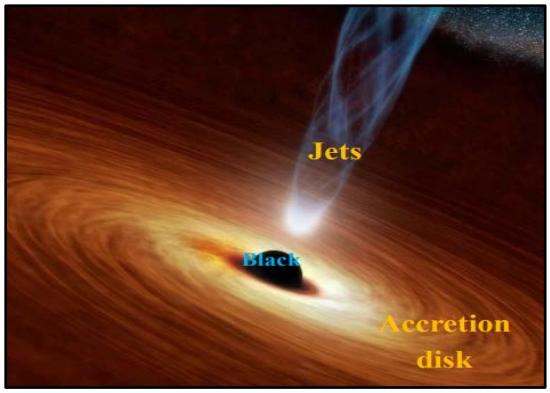
If the radius of Mercury's orbit around the Sun is constant, namely $\frac{\mathrm{d}r}{\mathrm{d}t} = 0$, we have $\frac{\mathrm{d}v}{\mathrm{d}t} = 0$, so that Mercury travels in an exact circle. If the ratio K changes over time but is a constant, namely $\mathrm{d}K/\mathrm{d}t = C$ from Equation (20), we have,

$$K\frac{\mathrm{d}r^2}{\mathrm{d}t} - m\frac{\mathrm{d}v^2}{\mathrm{d}t} = -Cr^2 . \tag{22}$$

In fact, the speed v_A in Equation (19) at which the Sun moves in the Milky Way galaxy is variable. Therefore, $-Cr^2$ is a critical term for the drift of Mercury's perihelion. Obviously, when this term is zero, Mercury's perihelion does not drift. The path of Mercury is an elliptical orbit which can be derived from Newton's gravity. The statistical equation of Newton's theory of gravity does not consider the change in the mass-energy of this entire system relative to the Sun over time, only the mass and distance factors. If considering the fine changes in the mass-energy of the Sun-Mercury system in Einstein's general theory of relativity, one can accurately get the change in the precession of Mercury over time. This comprehensive mass-energy change is missing from Newton's statistical equation of gravity. Therefore, Equation (22) can explain the reason of discrepancy between Newton's gravitational calculation and observation for the precession of Mercury. It also showed why the Einstein's theory can correctly predict the advance of the perihelion of Mercury. Clearly, the Mercury trajectory described by Newton's gravity is an average of general relativity (**Figure 1(a)**).



(a)



(b)

Figure 1. (a) The Newtonian orbit (red curve) is averaged by the Einsteinian orbit (blue curve) of a lone planet of the Mercury orbiting the Sun [43]. (b) Accretion disk and black hole (black ball) with its vertical extending polar plasma jets [47].

Indeed, in the solar system, every planet has precession relative to the Sun, and each moon has precession relative to its planet. Although general relativity does not give a physical explanation for Mercury's precession, its geometric mathematics describes Mercury's trajectory in relation to the Sun very well.

3.5. Binary Interaction of Two Black Holes

An astronomical black hole is a phenomenon or an event in which a large amount of celestial matter, including many stars, converges together. The Big Bang is the largest astronomical event. Black holes are most local astronomical events that occur in the current universe. Under the gravitational worldview, a large number of celestial bodies including light and other electromagnetic waves are all attracted by a huge black hole through its gravity [44] [45] [46]. Once these celestial bodies and lights enter the black hole, they are never heard from again. Under the inertial worldview, a group of the new particles from the initial Big Bang have their acceleration tendency and eventually converge into a black hole. In the process of convergence, the new particles are successively formed into stars in stages and batches to reach the black hole. Their collision as these

stars merge into the black hole creates a new universe. As a result, new physical state and new energy density are formed in the black hole. Any information in the black hole is difficult for people to know. However, the black hole has its accretion disk, event horizon, and polar plasma jets (**Figure 1(b)**). On the accretion disk, there are spiral arms that resemble those outside the center of the Milky Way galaxy, where celestial matter is converging towards the black hole in the form of mass acceleration [47]. The horizon separates the inside and outside of the event. The interior of the horizon is the new universe formed after the collision. The shear stress generated by the collision of the celestial masses converging on the accretion disk into the black hole drives vertical extending polar plasma jets. The polar plasma jets are particles of the new universe that are also expanding at an accelerated pace. Hence, the process of a black hole formation can be dynamically described by Equation (10) and Equation (12).

Each black hole is undergoing a similar evolution, driven by the particle shear stresses from the Big Bang. The formation of each black hole is not its final step rather than an intermediate process. The final step of two, or even more black holes, is to converge to their common center. As the trend of two black holes approaches, spiral arms around them also circle around a common center of rotation. This phenomenon is a binary black hole system consisting of two black holes in close orbits around each other [48]. Over time, two black holes can collide right or other angles. The dynamics of the orthogonal collision of two black holes are described by Equation (10), while their mass-energy conversion is described by Equation (17).

Of course, the collision between two black holes is not necessarily orthogonal. If two black holes collide with an angle θ, the energy density produced by their collision is $\sin\theta < 1$ times of the energy density of the orthogonal collision. This is clearly found from Equation (11). The proving the existence of a binary black hole is experienced many years because of the nature of black holes themselves and the limited means of detection available. However, its existence has been proved when detected that a pair of black holes were to merge to erupt an immense amount of energy. The existence of binary stellar-mass black hole was finally confirmed when LIGO detected GW150914 at 0950 UTC on 14 September 2015, a distinctive gravitational wave signature of two merging stellar-mass black holes of around 29 and 36 solar masses, occurring about 1.3 billion light-years away [49]. It released around 3 solar masses as so-called the energy of gravitational waves. Three solar masses were converted to new energy flux in the final fraction of a second, with a peak power 3.6×10^{56} erg/s [50]. Judging from the energy released and mass-energy converted, the two black holes detected by LIGO are not the orthogonal collision, but other angles. The essence of the so-called gravitational wave signal detected on Earth is the release of new energy into space when two black holes collide.

The result of two close black holes interacting may also be the same as the final relationship between the Earth and the Moon, rotating around their com-

mon center. Since then, the two black holes have only rotated with each other and have not merged or collided. Whether two black holes, or several black holes, can collide depends on the shear stresses of the most primitive particles that make up these black holes and the distribution of their two force components in Equation (18). An orthogonal collision between two black holes is one of the few extreme events. Most of binary black hole collision have a non-orthogonal angle, so only part of the mass of the black hole collision is converted into the energy of the new state of matter.

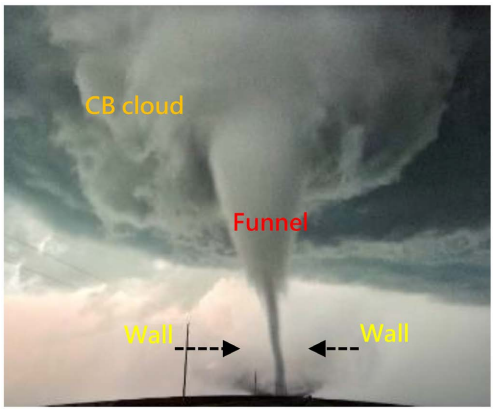
4. Macro Scale Universe

4.1. Tornadoes

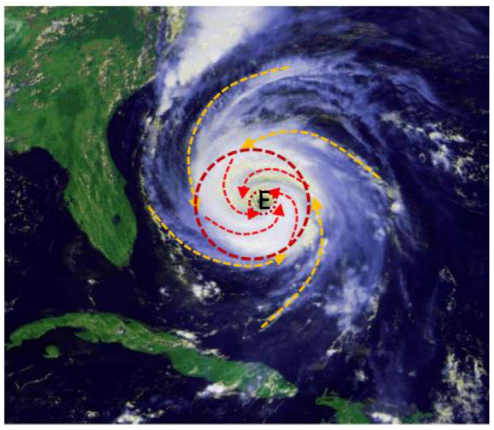
Since the Big Bang, the universe is a spacetime of expansion. The spacetime of the universe has the properties of matter and is a living process. The formation of the universe shows an extreme event expanding or exploding with its potential energy. The most extreme event that can be seen with the naked eye in the atmosphere is a tornado such as a photograph in **Figure 2(a)**. For tornadoes, their spatial diameter ranges from tens of meters to about hundred meters, and their life span ranges from minutes to tens of minutes. Tornadoes are limited in time and space by the external environment. Space and time are intimately linked to tornado. Therefore, a tornado is a macro universe.

A tornado has a process of formation and evolution. One can first observe a swirling dark cumulonimbus that appears in the sky near the surface level. Next, a rotating funnel-shaped cloud extends downward from the base of the rotating cumulonimbus. This rotating funnel-shaped cloud may not touch the ground. Once it touches the ground, it is called the grounded tornado. A grounded tornado can roll up soil and other objects and throw them into the surrounding air, forming wall dusts around a funnel-shaped cloud in **Figure 2(a)**. Grounded tornadoes cause tremendous damage wherever they go, indicating a huge energy density.

For a long time, the real dynamics of tornado formation was not well understood in meteorology. Recently, we have used automatic meteorological observations as well as satellite and radar positioning observations to find that tornadoes are the product of orthogonal airflow convergence (or collision). Tornadoes occur at the location and moment when 2 - 3 streams of airflows are the strongest in the lower atmosphere and close to collide or converge orthogonally [51]. The convergence or collision of airflows in the lower atmosphere is horizontal, which generate shear stresses in the vertical direction [52]. The convergence of the horizontal airflows produces the rotating cumulonimbus in **Figure 2(a)**, where the shear stresses drive the air rotation to extend upwards and downwards. The downward-extending shear stress forms the funnel-shaped cloud. The tornado structure captured in **Figure 2(a)** is similar to the astronomically described structure of a black hole. The swirling cumulonimbus in a tornado resembles an accretion disk in a black hole, while the funnel-shaped cloud in a tornado resembles



(a)



(b)

Figure 2. (a) Vertical structure of a tornado with an inner funnel-shaped vortex extended downward from the bottom of cumulonimbus while outer wall dusts rotating and rising from the ground [52]. (b) Horizontal structure of strong hurricane satellite cloud image with an outer cloud shield (white shaded ring with four red-dotted line arrows) around the inner eye (E, the central shadow with downdrafts) of hurricane and four spiral cloud-rain bands (yellow dashed-line arrow) around the periphery [52].

the polar plasma jets of a black hole. So, a tornado is a black hole in the atmosphere. **Figure 2(a)** is just a photograph of a single tornado. The formation process of a single tornedo can be dynamically described by Equation (10) and Equation (12). Multiple tornadoes can successively form in a tropical cyclone or an extratropical cyclone [53]. Tornadoes usually form at place of the orthogonal collision of horizontal airflows in the lower level of these cyclones [52] [54].

4.2. Tropical Cyclones

Extreme stormy weather as an extreme event has a low probability in most days of the year. In addition to the tornadoes mentioned above, the other two extreme weather systems in the atmosphere are tropical cyclone and extratropical cyclone. They are cyclonic rotating low-pressure systems where airflows converge or collide towards their centers, with convective weather in the center producing extreme precipitation. The difference is that tropical cyclones are symmetrical in

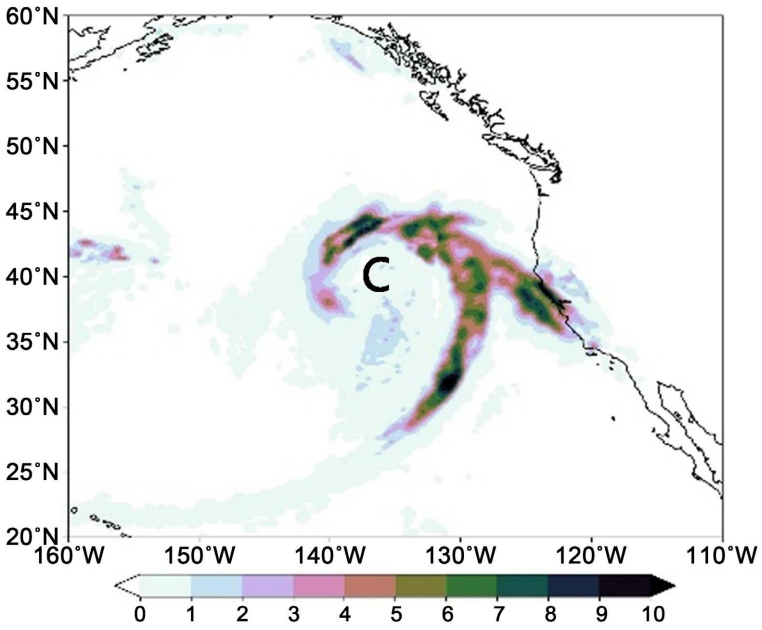
distributions of horizontal airflow, temperature and pressure, while extratropical cyclones are asymmetrical. Tropical cyclones form over tropical oceans, and extratropical cyclones form on planetary-scale fronts in the middle latitudes. Tropical cyclones are strong and the catastrophic damage caused is significant.

Tropical cyclones that occur in the Atlantic and Pacific oceans are called hurricanes and typhoons, respectively. **Figure 2(b)** is a satellite image of a hurricane that commonly occurs in the North Atlantic. Hurricane (typhoon) eyes can form when they reach their strongest. Cloudless in the eye area controlled by downdrafts. The eye area is surrounded by a white cloud-rain ring, which is where the updrafts occur. There are four symmetrically converged cloud-rain bands on the periphery of the cloud-rain ring. In **Figure 2(b)**, except for the white cloud-rain areas, the green ones are the terrain and the dark ones are the cloudless areas. The four spiral cloud-rain bands around the hurricane are distributed like the four stellar spiral arms of the Milky Way gaxay. The hurricane's cloud-rain ring is like the horizon of a black hole, with four rotating cloud-rain bands on an accretion disk. The eye at the center of the hurricane is like a new physical state of polar plasma jets formed in a black hole. The formation of hurricane eyes and cloud-rain rings is also an unresolved dynamical problem.

Dynamically, the four cloud-rain bands on the periphery of the hurricane carry water vapor to collide at the outer side of the hurricane's event horizon. As a result of the collision, the horizontally converging water vapor and airflows are converted into new mass (cloud and precipitation) and new energy moving vertically. So, around the eye of the hurricane, a vertical convective movement is formed. The largest horizontal flow convergence is located in the upper troposphere. Part of the horizontal airflow entering the width zone of cloud-rain ring converges towards the center of the hurricane, and the result of the collision or convergence is the formation of a downdraft in the center. Downdrafts form hurricane warm core and cloudless eye area [54]. Although the speed of the converging airflows around the hurricane is far lower than the speed of the converging nebula matter around the black hole, the dynamics and results of their collision after convergence are similar. The formation of the strongest hurricane can be dynamically described by Equation (10) and Equation (12). In fact, the motion of each small airmass in the atmosphere in **Figure 2(b)** is affected by two forces in Equation (18) at the same time. The pressure gradient force of the atmosphere balances these two forces.

4.3. Extratropical Cyclones

Extratropical cyclones initially form along frontal zones of temperature/dew point gradient and significant vertical wind shear, and are thus classified as baroclinic cyclones. In the Northern Hemisphere, extratropical cyclones move eastward along the westerly airflows. Extratropical cyclones can bring strong winds and heavy rainfall wherever they go. **Figure 3(a)** shows the precipitation amount centered at 1200 UTC 4 January 2023 for one hour interval, estimated



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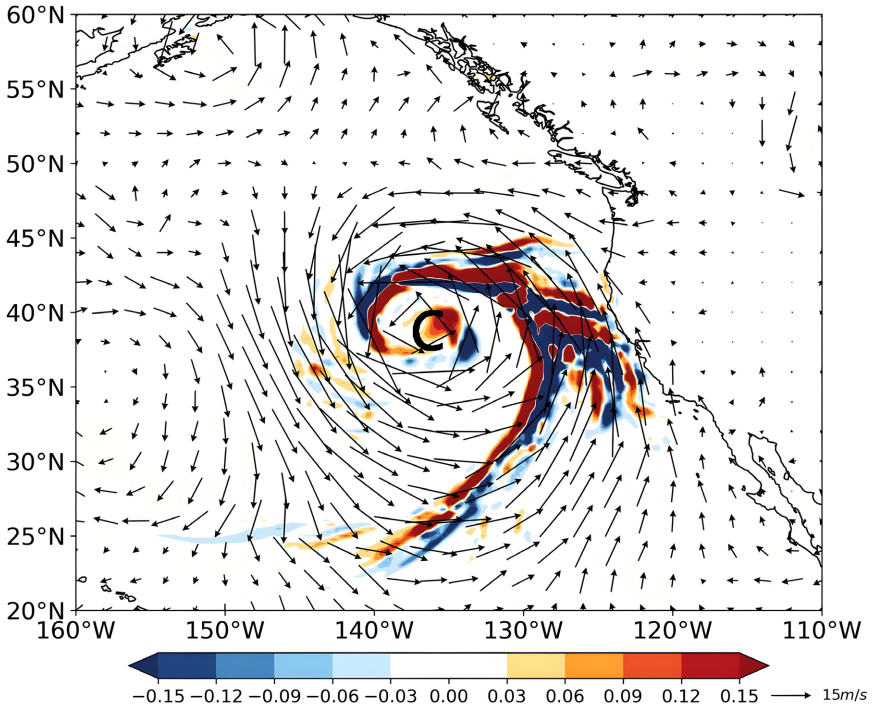


(b)

Figure 3. (a) The hourly precipitation amount (shading, mm/h) centered at 1200 UTC on 4 January 2023. (b) Anomalous winds (m/s) of an extratropical cyclone and anomalous moisture stress modulus (AMSM, τ_q', shading, 0.03 $m^4 \cdot s^{-4} \cdot kg^2 \cdot kg^{-2}$ interval) at 850 hPa at 1200 UTC on 4 January 2023, with red and blue shadings associated with updrafts and downdrafts. The letter C indicates the center of extratropical cyclone.

by meteorological satellites. Heavy precipitation of 7 mm per hour shown in the shadow has affected the west coast of California in the United States. The main

body of the extratropical cyclone will also move towards the west coast of California. Forecasting the intensity, location and timing of extreme precipitation has always been a meteorological challenge.

This weather forecasting problem can be solved by using the orthogonal collision theory. From Equation (11), the anomalous moisture stress modulus (AMSM, τ_q') or anomalous energy density per unit area can be written as,

$$\tau_q' = \left(q_A' v_A'^2\right) \cdot \left(q_B' v_B'^2\right) \cdot \sin\theta \,. \tag{23}$$

where, q_A' and q_B' are the two anomalous moisture masses (two masses m_A and m_B of anomalous specific humidity) which are driven by the two anomalous airflows with their speeds v_A' and v_B'. The positive and negative values of τ_q' show vertically upward and downward motions of new airflows produced by the convergence or collision of horizontal airflows. It is important to note that extreme precipitation is a product of anomalous energy release, so it is necessary to decompose the observed total winds into climatological and anomalous components [54] [55]. The convergence or collision of anomalous airflows has certainly contribution to extreme precipitation [52]. Two conditions are required for extreme precipitation in the atmosphere: vertical speed and saturated water vapor. Water vapor is mainly concentrated in the lower atmosphere. There are many meteorological methods for estimating vertical airflow, but all of them do not correspond to the location, intensity, and timing of extreme precipitation [56]. The strongest convergence of atmospheric horizontal airflows is in the upper troposphere, but there is a lack of water vapor aloft. Therefore, the convergence or collision of horizontal airflows at 850 hPa in the lower troposphere will lift the saturated water vapor there, resulting in extreme precipitation. For the vector form in Equation (23), the term $\boldsymbol{\tau}_q$ is a vector vertically indicating the potential energy associated with extreme precipitation, which is perpendicular to the plane of two anomalous airflows $\boldsymbol{v}_A'$. and $\boldsymbol{v}_B'$.

Figure 3(b) is the spatial distribution of calculated AMSM (τ_q') according to Equation (23) at 850 hPa at 1200 UTC on 4 January 2023. The red and blue shadings respectively indicate the upward and downward movements. The place of the upward movement corresponds to the precipitation. The AMSM (τ_q') is equivalent to the energy density for forming a new material such as precipitation, fog, and hails. This means that new energy density can trigger the extreme precipitation. Therefore, if integrating the AMSM centered at the time of **Figure 3(b)** for one hour interval, we can get a spatial AMSM distribution to indicate the hourly precipitation as shown in **Figure 3(a)**. In **Figure 3(b)**, the greater AMSM occurs in the place where the convergence angle of two anomalous airflows is close to a perpendicular. This example shows that the horizontally converging water vapor (gases) produces precipitation (liquids) and even hails (solids) associated with the vertical motion. This is an example on a macro scale, showing that the orthogonal collision of old horizontal airmasses (water vapor) can generate new state of matter (precipitation).

Tornadoes, tropical cyclones, and extratropical cyclones are all separate spacetimes or universes that occur in the atmosphere and are extreme weather events. They are all natural phenomena of life processes in different spacetimes. Local orthogonal collisions or multi-angle collisions of horizontal airflows can produce new universes, resulting in different new states of matter such as heavy rainfall or dust storms [52]. The new state of matter is an extreme event with the release of an abnormal energy density. Two cyclones rotate and merge with each other, forming an enhanced cyclonic storm, which is like the merger event of two black holes.

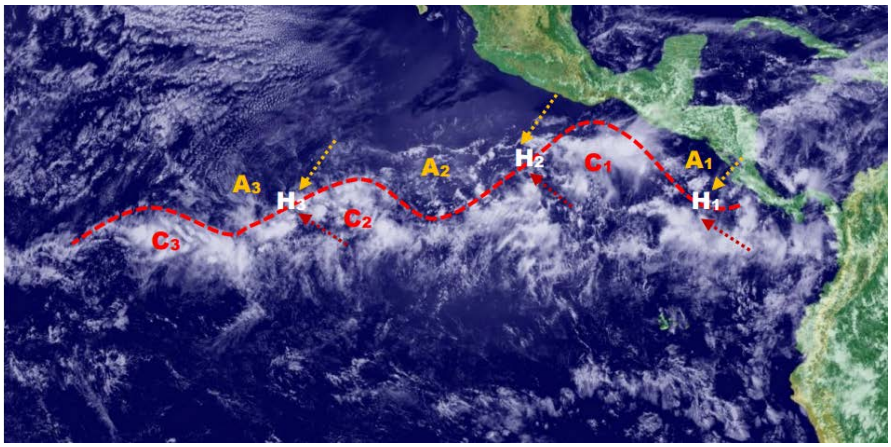
4.4. Mountain Uplift

All astronomical observations, including moons, planets, stars, and larger galaxies, are traces of the early universe evolution after the Big Bang. The spatial distribution of continents and oceans on the Earth's surface, especially the uplift of the Tibetan Plateau, is traces of the early Earth evolution. Modern geodynamics is also developed in the early 20th century. Although Wegener proposed the theory of continental drift at the beginning of the 20th century [57] [58], it is not clear what is the real driving force [59]. According to the previous description, the Earth is the result of the accelerated expansion and convergence (or collision) of new particles at the target Earth location after the Big Bang under their shear stresses. In the process of particle convergence or collision, the temperature continues to rise, and the material starts to stratify. In the early days of the Earth's formation, angular momentum was significantly exchanged between the outer magmatic fluid and the inner solid core. When the core loses angular momentum, the magmatic layer gains angular momentum. As a result, magmatic fluids, especially the upper-layer ones, have an eastward speed relative to the Earth's core. The eastward speed is in turn affected by the deflection force of the Earth's rotation towards the equator. Thus, the upper magmatic fluid in the Northern Hemisphere exhibits a southeastward movement, and the upper magmatic fluid in the Southern Hemisphere exhibits a northeastward movement [60]. The essence of this deflection force or Coriolis force is the rotational centripetal force --the second term in Equation (18). As the Earth began to cool and the early crust formed, the crust of the polar regions was thicker than that of the equatorial zone. We use the drive of the upper magmatic fluid to describe the early split and drift of the primordial continents.

The angular momentum exchange relationship between the magmatic layer and the inner core in the early Earth and the planetary-scale circulation movement of magmatic fluids are like that of the current atmosphere and solid Earth. If there are no land-sea and topographic differences in the underlying surface of the global atmosphere, a horizontal airflow intertropical convergence zone (ITCZ) should form in the atmosphere, located along the equatorial zone. Due to the influence of land and sea distribution and topography, the ITCZ in the atmosphere is off the equator. Southeast and northeast trade winds appear cli-

matologically on both sides of the atmospheric ITCZ. The trade wind convergence zone reflects the ITCZ on the north side of the equator in the eastern Pacific. However, the trade wind convergence zone is unstable so that disturbances often occur on it, forming concentrated cloud-rain areas (**Figure 4(a)**). The three areas of white clouds detected on the satellite image are three tropical cyclones, which is like the hurricane embryos in **Figure 2(b)**. These cloud areas can be comparable with computed AMSMs yielded by Equation (23) [52].

In the early days of the Earth's formation, the crust at the poles was thicker than the crust along the equatorial zone. The two thicker crusts in the mid- and high-latitude zones were driven by the southeastward movement of the upper magmatic fluids in the Northern Hemisphere and the northeastward movement



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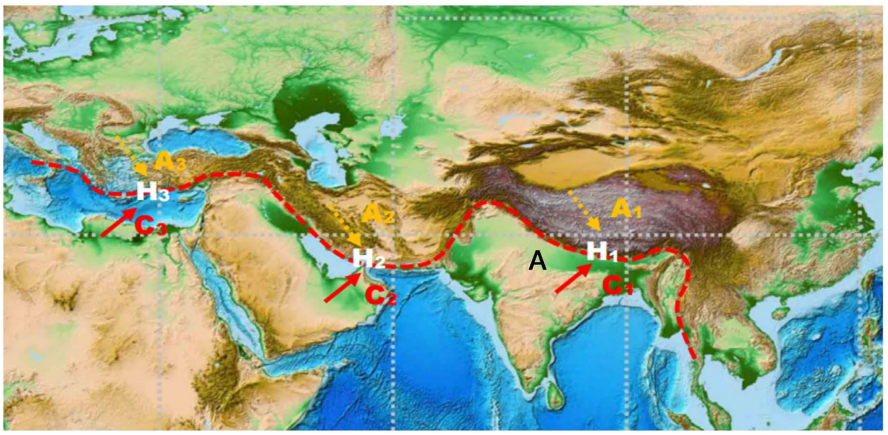


(b)

Figure 4. (a) Three tropical cyclones (white cloud areas C1, C2, and C3) and three anticyclones (cloudless areas A1, A2, and A3) observed by polar-orbiting satellites. The red-dashed line is the intertropical convergence zone (ITCZ) with anomalous northeasterly airflows (yellow arrow) and anomalous southeasterly airflows (red arrow) [61]. (b) Three plateaus (A1, A2, and A3) are separated by three valleys (C1, C2, and C3) in southern Asia [61]. The red-dashed line is the convergence zone of upper magmatic fluids with anomalous southeastward magmatic flows (yellow arrow) and anomalous northeastward magmatic flows (red arrow).

of the upper magmatic fluids in the Southern Hemisphere, and they have undergone the most primitive split and drift. The split continents in the Northern Hemisphere drifted southeastward and the split continents in the Southern Hemisphere drifted northeastward. Since the primitive continental split was not uniformly distributed, the circulation structure of the upper magma relative to the equator was changed during the continental drift. As a result, the convergence zone of the upper magmatic fluid also deviates from the equator, shifting to the north side of the equator in the Eastern Hemisphere and to the south side of the equator in the Western Hemisphere [60]. In addition to planetary-scale convergence, there are also regional perturbations in the upper magmatic fluids on both sides of the convergence zone. **Figure 4(b)** shows the location of the upper magmatic fluid convergence zone located in southern Eurasia during the first continental drift (red dotted line).

In **Figure 4(b)**, the yellow arrows indicate three streams of anomalous magmatic fluids from the north side of the convergence zone, and the red arrows indicate three streams of anomalous magmatic fluids from the south side of the convergence zone. The anomalous upper magmatic fluids on both sides of the convergence zone collided orthogonally. Under the drive of upper magmatic fluids, the continental crust on the southern side of the convergence zone was subducted, while the continental crust on the northern side was uplifted. Only such orthogonal collision has enough vertical movement energy to uplift the continental plates to a height of several kilometers, forming an alignment of three east-west oriented plateaus or large mountains located on the southern side of Eurasia [61]. Hence, the process of mountain uplift can be dynamically described by Equation (10) and Equation (12).

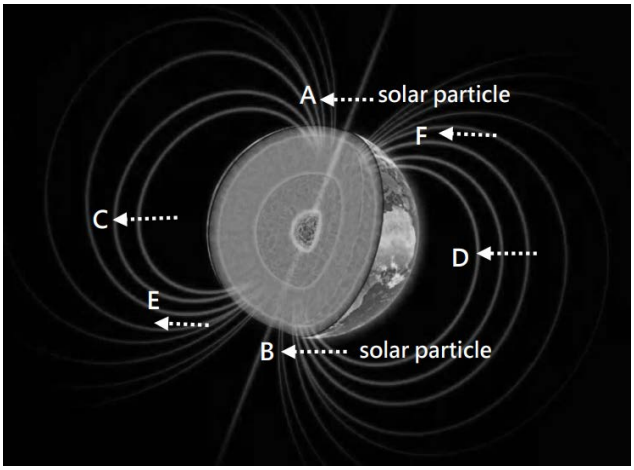
5. Micro Scale Universe

5.1. Aurora Phenomenon

One of the most spectacular shows that the natural light offers in the northern latitudes is the so-called Aurora Borealis [62]. Aurora is a colorful plasma phenomenon that occurs due to the flow of charged particles (solar wind) from the Sun entering the Earth's magnetic field so that the brilliant and beautiful glow appears at clear-sky night near the north and south poles of the Earth. At the Space-Weather website of USA [63], the northern lights are thought to be the result of accelerated electrons or strong electrically charged solar wind particles colliding with air molecules (or oxygen and nitrogen atoms) in the Earth's upper atmosphere. The auroras typically form about 80 to 500 km above the Earth's surface and usually occur between 60 and 75 degrees of the latitude zone.

Using orthogonal collision theory from Equation (10) and Equation (12), we can explain the dynamical mechanism of aurora formation. First, it is necessary to explain accelerated electrons or strong electrically charged solar wind particles. The solar wind refers to the energetic particles emitted by the activity of storms and sunspots on the Sun. After the Big Bang, the particles converging on

the Sun are still moving at an acceleration according to the two forces in Equation (18). The fusion plasma on the Sun has relative motion between different layers and between different latitude zones. The vortex formed by these relative motions and the orthogonal collision of these particles in their plasma again form newer particles. These newer particles are strong electrically charged solar wind particles with higher energy. In Figure 5(a), the dotted arrows indicate strong electrically charged solar wind particles that have reached the space around the Earth.



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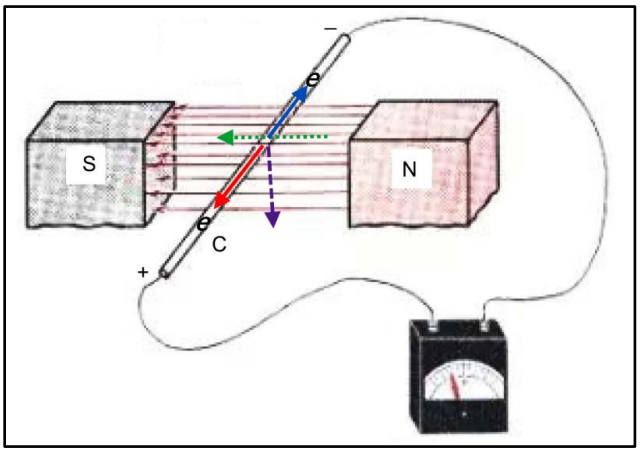


(b)

Figure 5. (a) An ideal schematic pattern of the distribution of solar particles (dotted-line arrows) and geomagnetic lines (white lines) [66]. Letters A, B, C, and D indicate four points where anomalous solar wind particles collide orthogonally with geomagnetic ions moved along the geomagnetic lines. Letters E and F indicate two points where particles and ions respectively collide with their angles of 0 and 180 degrees along straight lines. (b) A simple device for electromagnetic induction [71]. 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.

As mentioned earlier, the Earth was also formed by the convergence or collision of particles after the Big Bang. In the early days of the Earth, there were only the solid core and the outer layer of magmatic fluids, which have angular momentum exchange between them. When the Earth cools, a thin crust is formed. However, there is still an exchange of angular momentum between the solid core and the magmatic layer, and the drift of the continental plate was driven by the upper magma. The early magmatic fluid layer is the present mantle layer. The exchange of angular momentum still exists between the core and the mantle. Their relative motion is a huge electrical generator that forms the Earth's magnetic field. The inversion of the Earth's magnetic field and the change in the position of the north and south magnetic poles reflect the relative movement between the core and the mantle. The geomagnetic direction or polarity is reversed depending on whether the mantle rotates relative to the core fast or slow, which is called the geomagnetic reversal. In the geological history of the Earth, the geomagnetic polarity has been inverted many times [64]. Geomagnetic inversion was recorded in sediments distributed parallel on both sides of the mid-ocean ridge [65].

The relative motions between different layers on the Sun can form accelerated particles. Similarly, the relative motions of different layers in the Earth's interior can also form accelerated particles or strong charged ions. These ions move along the white line in **Figure 5(a)**. At the points A and B, accelerated solar particles collide orthogonally with the Earth ions [66]. As a result of the collision, new energetic particles are triggered, which are the aurora phenomenon that can be observed at nighttime. At the point C, the particles emitted by the Sun are blocked by the Earth and do not collide with the ions. At the point D, solar particles collide orthogonally with the ions, but occur during the daytime, and the aurora is not visible to the naked eye. At the points E and F, there is a rear-end collision and head-on collision between the solar particles and the ions, but the shear stress is zero so that no new energy density occurs. The Big Bang produced the first generation of new particles. The accelerated particles from the Sun are the second generation of new particles. The aurora phenomenon observed on Earth is an energy flare of the third generation of new particles. Thus, if there is relative motion between the inner layers of planets and moons, the ions they excite will interact orthogonally with the solar wind particles, forming auroras.

5.2. Electromagnetic Induction

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 [2] [3], while the theoretical research on magnetism began with the discovery of Oersted's law in 1820 [67]. From the 1850s through to the 1870s, Maxwell summarized a set of theoretical equations for electromagnetism based on some laws of predecessors [68] [69] [70]. However, this set of equ-

ations contains a few statistical relationships and empirical concepts, so it is difficult to explain the physical nature of electromagnetic phenomena and principles. The macro phenomenon of electricity can be explained as the separation of unlike charges of new electrons produced by the orthogonal collision of old objects under the action of external forces [71].

From Equation (12), total number of new unlike charge particles produced by the orthogonal collision of two old objects of $\tilde{m}_A$ and $\tilde{m}_B$ with their speeds $\tilde{v}_A$ and $\tilde{v}_B$ is *N*. The mass-energy relationship between the old objects and new particles is [71],

$$\tilde{m}_A\tilde{v}_A^2 \cdot \tilde{m}_B\tilde{v}_B^2/\tilde{r}^2 => \frac{N}{2}m^+c^2 + \frac{N}{2}m^-c^2 \tag{24}$$

where, m^+ is a mass of positive charge and m^- is a mass of negative charge, $\tilde{r} = r_A = r_B$. Equation (24) shows that two objects collide orthogonally and produce *N*/2 new particles with positive charge and *N*/2 new particles with negative charge. An orthogonal collision between two saturated moist air masses as two old objects can create unlike charges and separate a positively charged cloud body and a negatively charged cloud body. Each cloud body has *N*/2 new particles. If a pair of positive-negative charged cloud bodies are connected by a wire, there will be an electric current on the wire. The symbol "=>" indicates that the charged cloud bodies formed by the collision of two old air masses are unidirectional. When unlike charges are accumulated in two adjacent cloud bodies and reach a certain value, the lightning or discharge phenomenon occurs between them. 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. This is a potential energy caused by unlike charges.

There is a relative movement between the outer magmatic fluid layer and 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 magmatic layer changes, the direction of electric current and the direction of the magnetic poles also change. Mid-ocean ridges are places where 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.

Magnetism reflects an overall orientation of the moving electrons formed in the rocks under the action of ambient electric 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 de-

noted 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 $\boldsymbol{\pi}$ [71],

$$\boldsymbol{\Pi}_{\pi} = \boldsymbol{\Pi} + \boldsymbol{\pi}. \tag{25}$$

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.

The physical nature of electromagnetism is clear. Electricity refers to the potential energy formed by two adjacent unlike charges, which is produced by the collision of objects (particles). Magnetism is a storage of electrical energy and information caused by the overall orientation of the moving electrons in a material. Electricity and magnetism are the potential energies or inertia that objects (particles) have but they are products left by a previous orthogonal collision. The physical explanation for electricity is that the action of external forces not only forms new particles, but also separates the unlike 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.

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 [72]. However, the mechanism behind the generation of vortical electric field and their specific relationship with the magnetic field is still not fully understood. In **Figure 5(b)**, 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 left. The green-dotted arrow indicates the overall orientation solidified for the moving electrons. It reflects the potential quantum energy between the two poles N-S of the magnet.

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 moving direction (purple-dashed arrow) 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, only when the vertical movement of the metal rod relative to the magnet can generate current? The direction

of moving electrons in a stationary metal rod is disordered. But when the metal rod is artificially moved horizontal or vertical, the 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).

In **Figure 5(b)**, if the metal rod does not move, changing the strength of the magnet can also generate the directional movement of new electrons or electric current in the metal rod. 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 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.

From Equation (24), the energy of a pair of positive-negative electrons is,

$$E^{+,-}=\frac{1}{2}m^{+}c^{2}+\frac{1}{2}m^{-}c^{2}=\left[\left(m_{A}\cdot m_{B}\right)\cdot\left(v_{A}\cdot v_{B}\right)^{2}\right]\Big/N\frac{q^{+}\cdot q^{-}}{r^{2}}. \tag{26}$$

where, q^{+} is positive charge and q^{-} is negative charge. If taking $k'=\left[\left(m_{A}\cdot m_{B}\right)\cdot\left(v_{A}\cdot v_{B}\right)^{2}\right]\Big/N$, then,

$$E^{+,-}=k'\frac{q^{+}\cdot q^{-}}{r^{2}}. \tag{27}$$

Obviously, Equation (27) has the same form as Coulomb's law. The physical essence expressed in Equation (27) is the energy of unlike charges, not an electric force ($F=k\frac{q^{+}\cdot q^{-}}{r^{2}}$) acted on two charges as given by Coulomb's law [73]. The Coulomb's statistical constant is $k=\frac{1}{4\pi\varepsilon_{0}}$ and ε_{0} is the vacuum permittivity. In Equation (27), there is not an electric force between the unlike charges q^{+} and q^{-}, but rather the potential energy between charged particles. Here, there is no electric force so that there is also no magnetic force. Standing on Newton's gravitational worldview, Coulomb got the law of electricity.

In Equation (26), if taking $G'=\left(v_{A}\cdot v_{B}\right)^{2}\Big/N$ and without considering unlike charges, then,

$$E=mc^{2}=G'\left(m_{A}\cdot m_{B}\right)\Big/r^{2}. \tag{28}$$

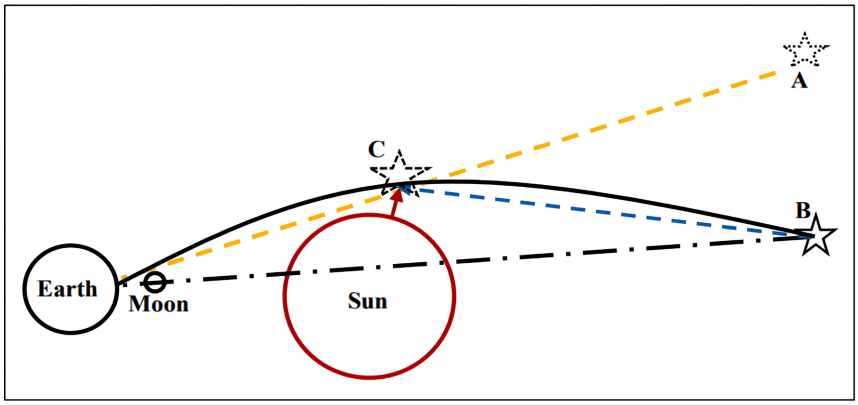
In Equation (28), the form of the right-hand side is the same as that of Newton's gravitational force $G'\left(m_{A}\cdot m_{B}\right)\Big/r^{2}$, but here it is the energy. Its physical explanation is that two objects with masses m_{A} and m_{B} in the old universe collided orthogonally, producing N new particles in the new universe. Each new particle

potential energy $E=mc^2$ is equivalent to one of total N mass-energy parts produced by two old objects collided orthogonally, which is the form of Einstein's mass-energy formula. Similarly, from Equation (26) to Equation (27), the physical explanation is that two objects m_A and m_B in the old universe collided orthogonally, resulting in N different charged particles in the new universe. The potential energy $E^{+,-}=k'\frac{q^+\cdot q^-}{r^2}$ associated with each new pair of charged particles is equivalent to two of total N mass-energy parts produced by two old objects collided orthogonally. At this point, we have connected or unified the potential energy related to electricity and the potential energy related to mass inertia. The physical mechanisms by which various potential energy arises are orthogonal collisions of matter [73]. Thus, the orthogonal collision theory has realized Einstein's wish to unify the cosmic celestial theory with the micro electronic theory.

5.3. Gravitational Lensing Effect

Einstein proposed the general relativity in 1915 and published his paper in 1916 [9]. This theory holds that gravity is not a force as described in Newton's theory, but a relative feature of spacetime [74]. In his new theory, space and time are merged into "spacetime", such that spacetime participates in the physical processes of a matter motion. According to the general relativity, objects with larger masses in the universe, such as planets and stars, bend the spacetime around them and determine the motion of relatively small objects including light. Thus, Einstein proposed the inference of whether the light of a star can be bent by the gravitational pull of the Sun and hoped to compare with observations. In 1919, two sets of British observations came from Sobral in South America and Principe in Africa [75]. The analysis of the observational data is shown like the path of starlight in **Figure 6(a)** radiating from the real location of star B.

However, Lodge in 1919 pointed out that it is "not permissible to say that the solar gravitational field acts like a lens, for a gravitational lens has no focal length" [76]. In 1936, Einstein used the phrase "lens-like" instead of "lens" [77]. Since then, gravitational lensing has become a powerful research tool for exploring the distribution of matter and energy in the universe, as glare phenomena around the Sun and around massive galaxies are indeed observed on the Earth [78]. In the book "Truth and Beauty" of Chandrasekhar, he cast doubt on Einstein's gravity of the Sun altering the curvature of stellar light [79]. He argued that it is only a corollary and not any precise prediction based on the theory so that it relies solely on the empirical judgment that the stellar light is affected by gravity. He further noted that so far there has been no verification of any precise features of general relativity in observations, nor for some time to be expected in the future. Several years ago, a review article proposed some questions about gravity such as the phenomenon of gravitational lensing as well as observed rotational velocities of stars orbiting the galactic center that are deviating from Newton's law [80].



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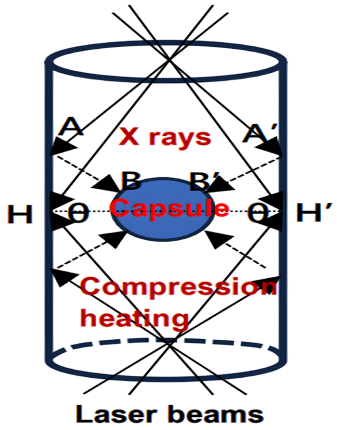

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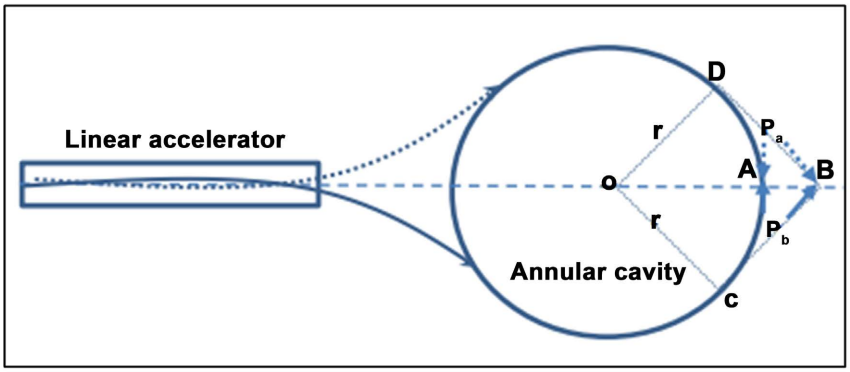

(c)

Figure 6. (a) Optical schematic diagram of a gravitational lensing effect [81]. The Earth, the Moon, the Sun, and a real star B are along a dotted straight line during a total solar eclipse while point A is the apparent position of the star observed from the Earth. The solar particle (red arrow) orthogonally collides at the point C with a partcle (blue dashed arrow) emitted from the star B. (b) A device of laser indirect drive (LID) for laser driving inertial confinement fusion ignition [83] [85]. The black-solid arrow is incident laser beams from the outside of hohlraum (cylindrical x-ray oven). The black-dashed arrow indicates the part of refraction or x rays. (c) Linear collider and orthogonal collider show that two high speed particles *Pa* and *Pb* come from linear accelerator and linearly collide at the point A along the annular cavity with the radius *r* and orthogonally collide at the point B [27].

According to the proposal of Einstein and the observational analysis in 1919, Figure 6(a) shows the optical schematic diagram of a total solar eclipse. The Earth, the Moon, the Sun, and a real star B are along a straight line during a total solar eclipse while point A is the apparent position of the star observed from the Earth. Based on Newton's theory of gravitation, mass particles from star B are captured by the gravitational pull of the Sun so that one cannot observe the shining around the Sun on Earth. Based on Einstein's general theory of relativity, the mass particles from star B will partially orbit the Sun along a curved line through the point C. The particles originating the star B and passing through the point C will be visible on Earth. During a total solar eclipse, the intense sunlight is blocked by the Moon. The observer mistakenly thinks it is the light from a star at point A. If this is the case, Einstein's general theory of relativity has once again been confirmed by astronomical phenomena.

Based on the orthogonal collision theory, the bright light at the point C is the result of the orthogonal collision of the accelerating mass particles from the star B and the accelerating mass particles from the Sun. Old particles collide constantly on the star B and old particles collide constantly on the Sun forming their new particles. These new particles radiate into outer space at an accelerating pace. The new particles from the star B and the new particles from the Sun collide orthogonally at the point C and other points forming a bright ring faced to the star B surrounding the Sun. This orthogonal collision ring generates a new energy density, which is the light observed by an observer on Earth [81]. Obviously, according to the general theory of relativity, the particles from the star B follow a curved trajectory to the point C, and they do not produce a gain in particle energy, making it difficult to observe flares on Earth. Thus, general relativity can geometrically describe the relative motion between celestial bodies, but it is difficult to describe extreme optical phenomena dynamically formed in the universe.

5.4. Modern Applications

One of the purposes of understanding the essential problems and rules of physics is application. Of course, some statistical laws on physical phenomena, such as the Newton's law in universal gravitation, the Coulomb's law in electricity, the Planck's law in quantum theory, the Einstein's law in photoelectric effect, and Maxwel equations have been applied in practice. Using orthogonal collision theory, two possible applications in high-energy or plasma physics are explored here. An application is the laser driving inertial confinement fusion ignition, hoping to get an artificial energy gain. Another application is the construction of high-energy particle colliders in the hope of discovering new particles.

Nuclear fusion occurs when two atoms are slammed together to form a heavier nucleus and release a massive amount of energy. Meanwhile, nuclear fusion releases zero carbon emissions, meaning fusion power plants could one day play a vital role to alleviate climate change [82]. On December 5th, 2022, the US Na-

tional Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) announced that a nuclear fusion experiment produced more energy than they put into the experiment, which was the first time in history [83]. The energy gain of the experiment is 1.537 which is a ratio of the output energy 3.15 megajoules (MJ) to the input energy 2.05 MJ. A goal is that the energy gain hopes to larger than 2.

In this experiment, the device of laser indirect drive (LID) shows that the driver energy from 192 laser beams is first absorbed in a hohlraum (an oven) and created x rays, which surrounds a deuterium-tritium (DT) fuel capsule to ablate its surface with high pressure [84]. Finally, the capsule accelerates inwards and converts kinetic energy into internal explosion energy which completes a process of fuel capsule implosion. **Figure 6(b)** shows the device of laser indirect drive. 192 laser beams are incident into the oven generating a bath of x rays [85] [86]. All of incident laser beam energies will use to produce compression heating and high pressure in the oven. One of laser beams reaches the point A (or A') with its kinetic energy $E = 1/2 \cdot mv^2$ and then partly produces heating (internal energy) at the point A (or A') and partly refracts to the point B (or B') with kinetic energy.

A pair of laser beams are incident from the top and the bottom of the oven hitting the point H (or H') with a collision angle ($\theta > 90^\circ$) of two laser beams. According to Equation (10) and Equation (11), this collision pair of two laser beams partially forms new energy density with the shear stress perpendicular to the collision plane. A flat pancake-shaped distribution of new energy density is generated between the two points H and H' in the oven because many other pairs of laser beams also hit with increased angles than at the two points. This energy distribution can explain the observed phenomenon of the flat pancake-shaped implosion and the sausage-shaped implosion [82]. Most laser beams have not formed collision pairs so that they have not generated new energy density. Between the points A and H and between the points A and B, different energy gradient and asymmetrical energy distribution are spatially formed surrounding the fuel capsule. The produced plasma instability can explain why the laser energy of indirect drive is absorbed only about 10% and converted into kinetic energy only about 1.5%. So only a small fraction of internal energy and kinetic energy remained acts on the capsule implosion. For the final hot-spot ignition, only a small fraction about 4 percent of the DT fuel is consumed in the December experiment.

The above data or evidence showed that that LID inertial fusion scheme is energy inefficient. To achieve the ultra-high energy density acting on the fuel capsule for the ignition, the Lawson condition on high pressure, temperature and confinement-time duration is required [87]. On the other hand, the symmetry control for reducing hydrodynamic instability and laser-plasma instability needs to be considered when designing any sort of laser driven inertial fusion scheme. The observed phenomenon of the flat pancake-shaped implosion be-

tween two points H and H' in the oven is evidence that those pairs of laser beams satisfy Equation (11) when they collide with some angles. An idea is to divide 192 laser beams into 96 pairs, making each pair of laser beams collide orthogonally on the shell of capsule. The maximum energy density will occur at each orthogonal collision point of laser beam pair. 96 pairs of laser beams need to be symmetrically distributed and orthogonally collided on the fuel capsule surface, to meet the requirements of instability controls. In this way, the capsule surface can rapidly increase temperature and pressure. At the same time, the new particles formed by the orthogonal collision will vertically converge towards the center of the capsule. According to the orthogonal collision theory, the device in **Figure 5(b)** needs appropriate improvements.

Exploring mysteries of the universe and finding new matter are the desire of physical research. The machine or device for such an exploration is a collider. Finding the newest and the smallest particles from colliders are a dream of physical scientists [88] [89]. Since the 1960s, many types of accelerators or colliders have emerged, such as positron-electron collider, electron-proton collider, electron-ion collider, and heavy ion collider. Positron, electron, proton, ion, and heavy ion are various energetic particles. Currently, all types of colliders are the linear (face-to-face) collision of particle beams. The goal is to form a concentrated energy or a new physical state, such as the appearance of Higgs particles observed at the Large Hadron Collider in 2012 [90] [91] [92]. The discovery of new particles has led to the desire to build larger linear colliders [93] [94]. Of course, such larger linear collider costs very high.

The conventional linear collider is constructed in a way that it first uses several accelerators to gradually accelerate the two beams of particles that are injected, and then a head-on or linear collision happens when they reach a certain beam strength and energy [95] [96]. In the storm of particle collisions, only a few particles collide. People are going to measure the signs of particle collisions from electric light and flint and possibly discovering "new physical state". When high-energy particles bombard a stationary target in a collider or a vacuum cryogenic device, only the center-of-mass energy (cme) is effective during particle collision, which accounts for only a part of total energy. However, if two beams of high-energy particles moved head-on collision with high energies $E_{1,2}$ collide, the combined centroid system has the beam energies about $2E$ [97]. Under the above two devices, the energy density formed by the collision is low. Theoretically, the result of the linear collision is that the old objects in the old universe are shattered, not the new particles created in the new universe.

In **Figure 6(c)**, the linear accelerator produces two beams Pa and Pb of particles and enters the annular cavity. If they collide at the point A it is a form of linear collider so it will generate an energy density $2E$ still in an old universe. If they orthogonally collide at the point B the form is an orthogonal collider so it will generate an energy density $4E^2$ in the new universe as indicated in Equation (14). Therefore, the orthogonal collider is easier than the linear collider to gen-

erate new physical state [27].

The linear collider shows that two beams of particles linearly collide at the point A and the orthogonal collider shows that two beams of particles orthogonally collide at the point B. For the linear collider, several measurers should be placed surrounding the point A. For the orthogonal collider, two measurers should be placed vertically to the collision plane of two particle beams near the point B. The manufacture of orthogonal collider is relatively simple, just at the two determined points of an annular cavity with two beams of high-speed or high-energy particles moving along their tangent line and forming a crossing collision point outside the annular cavity. Another method is to construct a device that the particles emitted from two linear accelerators collide orthogonally. We believe that the orthogonal collision of two particle beams can economically produce new physical state.

In **Figure 6(a)**, a pair of particle beams orthogonally collides at the point C, which forms natural new physical state. In **Figure 6(c)**, a pair of particle beams orthogonally collides at the point B, which can form artificial new physical state. In **Figure 6(b)**, a pair of particle beams collide with an angle at the point H (or H'), which forms a high energy density point. In fact, particle collisions with various angles and energy distributions described above can be clearly observed from Feynman's interference experiments respectively with water waves and with electrons [6]. Beams of water molecules and electrons excited from their source pass through two holes in a wall, and the spatial distribution of new energy density after the collision of different particle pairs with various angles can be detected behind the wall. The new energy density of a particle pair collision can be quantitatively expressed by Equation (11). At the point where the pair of particle beams collide orthogonally, the new energy density reaches the maximum. At collided points of other angles, the new energy densities are greatly reduced. Thus, the new energy density formed by the collision is not simply equal to the linear sum of the energies of a pair of old particle beams.

6. Conclusions and Discussion

The totality of space and time makes up the universe. The birth of the new universe originates from an orthogonal collision of objects in the old universe. The new universe is expanding at an accelerating pace as an extreme event containing new particles with potential energy. The force of the accelerating expansion of the universe is the shear stress resulting from the orthogonal collision. The two components of the shear stress extend time and bend space, so the universe is spacetime. Objects in the old universe collide orthogonally to create a new universe, in which there is a one-way conversion from the mass in the old universe to the energy in new universe, but there is no information exchange. The mass-energy involved in the collision of objects in the old universe is equal to the total mass-energy in the new universe. The universe needs an objective description from the combination of mathematics and physics.

The largest orthogonal collision event known today was the Big Bang. All the new particles formed by the Big Bang have gone through 13.8 billion years since the singularity of high pressure and temperature. These new particles accelerate into space, forming early celestial bodies of various scales, including stars, planets, and moons, and their combinations. In the current universe, it is generally homogeneous and isotropic, but there are still local differences, which are manifested in the fact that cosmic matter continues to expand and tends to converge locally. The many old universes existed before the Big Bang. The matters in the new universe collide orthogonally to form a newer universe.

The Big Bang formed N new particles. Each new particle has two components of shear stress that move towards space with accelerating and centripetal motions, corresponding to the mass accelerating force and the mass rotation centripetal force. Gravitational force presents the accelerated motion of an object attracted by the center of the Earth that people can perceive. But the physical essence of gravity is the combined force from the mass accelerating force and mass rotation centripetal force of each particle after the Big Bang. Although gravity gives people the illusion of acting at a distance, it can be applied well in practical work and daily life. Gravity comes from a passive attraction to an object, whereas shear stress comes from an active driving effect on an object. Thus, there are two different worldviews (the gravitational worldview and the inertial worldview) describing the same natural phenomenon.

The study of physics under the gravitational worldview is to find gravitons, hoping to unify the imaginary gravitons with the real photons. Physics under the inertial worldview has taught people that gravitons do not exist. The essence of gravitons is new elementary particles produced by the orthogonal collision of matter since the Big Bang. These new elementary particles can be referred to as inertial particles, shortly the word "inertons". The inertial particle motion and combination of inertons have evolved into a colorful world that we can observe from microscope to telescope. Therefore, everything in the universe is made up of inertial particles (inertons).

Stars, planets, and moons are the result of the accelerated convergence of some new particles (original inertons) under the action of the shear stress after the Big Bang. These new particles of inertial acceleration converge or collide at the central locations of stars, planets, and moons, converting from kinetic energies into heat energies and producing nuclear fusions. The larger the object, the hotter it will be after the collision, and it will have a huge nuclear fusion capacity, becoming a luminous star. Adjacent groups of new particles converge to form a star system, such as the Sun and its planets and moons in the solar system. Lots of star systems are converging towards the center of the Milky Way galaxy under the shear stress. There are many other galaxies in the universe that are converging towards the center of a larger galaxy cluster.

In the solar system, Mercury is the planet closest to the Sun. After the Big Bang, the directional accelerating motion of a small group of new particles (in-

ertons) converged to form Mercury, which orbits the Sun in an elliptical motion under the action of the two components of shear stress. Mercury's motion is constantly changing relative to the elliptical trajectory of the Sun, which shows Mercury's precession. This precession is not the effect of the Sun's gravity but essentially comes from the inertial motion of shear stress after the Big Bang.

Under the action of the shear stress with two components, some adjacent groups of new particles (inertons) form two or more celestial objects of approximately equal or unequal size, such as the Earth and the Moon, or Mars and its two moons. They form a system of motion around their common center under the action of the centripetal force of mass rotation. Black holes are members of celestial systems that are still in the process of converging matter in a larger celestial system. Two adjacent black holes or several black holes may have a common tendency. When two or more black holes converge, they collide or merge, forming a new celestial body and releasing newer energy into space.

Orthogonal collision theory can be applied not only to explain the motion of celestial bodies on the cosmic scale, but also to explain the natural phenomena visible to the naked eye on the macro scale. One natural extreme event that is visible to the naked eye is a tornado. A tornado can look like a small black hole. The striking feature of a tornado is a funnel-shaped cloud that extends downward from a rotating cumulonimbus overhead, which energy has extremely destructive. This funnel-shaped cloud stretching towards the ground is the result of the shear stress with high energy density caused by the orthogonal collision of horizontal airflows.

Two other extreme weather systems in the atmosphere are tropical cyclones and extratropical cyclones. Tropical cyclones form over wide tropical oceans with abundant water vapor, and the convergence of horizontal airflows can develop into super hurricanes and super typhoons. The striking sign of a super hurricane is the appearance of a cloudless area of downdraft in the center, surrounded by a cloud-rain ring. There are four spiral cloud-rain bands around the cloud-rain ring, which carry water vapor and momentum to the center of the hurricane. The spatial structure of a super hurricane resembles a black hole. Extratropical cyclones effected by complex topography are formed in the middle and high latitudes, and the cyclonic circulation is spatially asymmetrical, so extreme precipitation forecasting has always been a problem. Vertical motion occurs where the horizontal airflows collide at right angle and other angles, so extreme precipitation as new material occurs when the anomalous water vapor is combined with the vertical motion in the lower atmosphere. Therefore, orthogonal collision theory can be applied to the diagnosis and prediction of extreme weather.

Orthogonal collision theory can also be used to explain the land-sea distribution and plateau uplift left over from the early evolution of the Earth. After the Big Bang, a group of particles (inertons) converged to the Earth's location and formed a system of the Earth's core and the magmatic layer. There is an ex-

change of angular momentum between them. When the magmatic fluids move eastward relative to the Earth's core, the magmatic fluids also take on the component of moving towards the equator. As a result, upper magmatic fluids drive continental split and equator-ward drift from the middle and high latitudes. A series of plateaus on the southern edge of Eurasia are the result of an orthogonal collision between the southeastward drift of Eurasian continent and the northeastward drift of the continents from the Southern Hemisphere.

After the Big Bang, the most primitive particles or inertons are formed. The local confluences of these particles under the shear stress formed cosmic celestial bodies. The orthogonal collision of micro particles on a huge celestial body forms newer particles. When accelerating particles from two different celestial bodies collide orthogonally, the new state of matter that occurs shines. The relative motion and collision of plasma particles on the Sun and stars are constantly taking place, excite the radiation of new particles, such as the solar wind. In planets or moons, the interaction between the solid inner core and the magmatic layer forms an electrical generator that can excite charged ions in their atmosphere. Auroras are formed when the solar wind particles collide orthogonally with these charged ions. Gravitational lensing effect is essentially an optical phenomenon in which high-energy particles of solar radiation collide orthogonally with foreign star particles.

Since Newton studied the phenomenon of gravity, many physicists have studied the phenomena of electromagnetism. The physical essence of gravity is the potential energy of the inertial motion of matter after the Big Bang. The physical essence of electricity is the separation of unlike charges of new particles caused by the collision of external forces acting on old objects. There is potential energy between two oppositely charged objects. The physical nature of magnetism is the solidification of the electrical directionality associated with potential energy. When an external force causes electrons in a conductor to collide orthogonally with respect to electrons in a solidified magnet, the current formed is called electromagnetic induction.

Physics has entered the stage of artificially simulating the natural environment, generating energy gain, and discovering new state of matter through particle collisions. Laser driving inertial confinement fusion ignition is a device that generates energy gain through particle collisions. The device of laser indirect drive discovered that a flat pancake-shaped distribution of new energy density is the result of the collision of laser particle pairs. If one can build all pairs of laser particle beams to collide orthogonally and to distribute symmetrically on the shell of capsule, we can get a better energy gain. There are many particle colliders in the world. But these colliders take the form of particles linearly colliding. If these linear colliders are to be revamped into the orthogonal collision of particle beam pairs, the energy density produced by such machine would be many times as that of linear one. The orthogonal collider could be a more efficient machine for physicists to search for new particles in the future.

The study of physics has always been on the road from a single and decentralized research to unified research. 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 unify electromagnetism and gravity. However, his efforts in the later decades did not meet expectations. The reason is that he shared Newton's gravitational worldview and had difficulty recognizing the new world and proposing new ideas and methods. Einstein extended the study for the universe from Newton's two-body statistical mechanics to multi-body geometrical mathematics, and Maxwell was only a mathematical summary based on previous electromagnetic laws. The concepts of electric force and magnetic force 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 and electric force, does not hinder people's practical application. However, such ideas and methods hinder academic research on the physical nature of things. A prime example is the painstaking search for graviton.

The orthogonal collision theory in this article explains astronomical phenomena on the cosmic scale, meteorological and geological phenomena on the macro scale, and various extreme optical-electrical phenomena on the micro scale. From the Big Bang to the perceived gravitational pull and the occurrence of various extreme events, orthogonal collision theory is inseparable in explaining their intrinsic nature. Newton, Maxwell, and Einstein, as well as many physicists, all stood on the gravitational worldview. They have used statistical mathematics to deduce many laws of physical phenomena, including some uncertainty parameters, which have promoted the progress of society and science and technology. Today, orthogonal collision theory can essentially interpret many physical phenomena without any parameters. It is hoped that the orthogonal collision theory will realize Einstein's dream of finding a theory of everything.

Although this theory diverges from established physics principles, it explains various phenomena or evidences across cosmic, macro, and micro scales. This is an alternative theory to Newton's gravitation theory for new scientific exploration. On the cosmic scale, this theory can well physically explain astronomical optical phenomena and laws of celestial motion. On the macro scale, geological traces of continental drift and mountain uplift as well as meteorological observations of extreme weather systems such as tornedoes and synoptic storms can be numerically simulated or calculated by using this theory. The orthogonal collision of horizontal motion fluids in the old universe can produce new physical state with vertical motion in the new universe. From the old universe to the new universe, there is a one-way conversion from mass to energy, but it is difficult to exchange information. In the same universe, mass is conserved, energy is conserved, and information is recognizable. On the micro scale, the phenomenon of the flat pancake-shaped implosion in the LLNL nuclear fusion experiment can be well explained by this theory. If the new design of ignition device based on

the orthogonal collision could get a better energy gain, it will be a validation or prediction for the theory. If a new state of matter can be discovered by orthogonal collision colliders, it will also be a verification or prediction of this theory.

Data Availability Statement

Two datasets are used in **Figure 3**. The wind is from "The International Grand Global Ensemble" project (TIGGE, http://apps.ecmwf.int/datasets/data/tigge/levtype=pl/type=cf/). The hourly precipitation based on satellite estimate is from the website (https://www.ncei.noaa.gov/products/climate-data-records/precipitation-cmorph).

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgements

The author wishes to thank the anonymous reviewers for constructive suggestions and comments and criticisms which have improved the paper. This work was supported by the National Natural Science Foundation of China (Grant Number: 41775067).

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