Unified Field Theory

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Abstract

Unified Field Theory, a concept pursued by Einstein, aims to explain the universe's fundamental forces: strong, weak, electromagnetic, and gravitational. Despite partial unification of forces, gravity remains elusive. This paper proposes that the universe is composed of objects and the cylindrical spiral motion of surrounding space, redefining time, mass, charge, and force. We derive a unified force formula and an extended Maxwell's equation integrating gravitational and electromagnetic forces, asserting that weak force is a result of nuclear and electromagnetic interactions. The four fundamental forces—gravitational, electric, magnetic, and nuclear—are all manifestations of the cylindrical spiral motion of space.

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I. INTRODUCTION

A. The History of Unified Field Theory

Unified field theory aims to describe all fundamental forces and particles through unified physical and virtual fields, a concept pioneered by Albert Einstein, who sought to unify general relativity and electromagnetism[1]. Maxwell's unification of electricity and magnetism was a significant step, followed by attempts to include strong, weak, and gravitational forces[2,3]. However, since the 1960s, research has focused excessively on microscopic particles, neglecting the role of space itself[4]. This paper critiques the current approach, suggesting that mass acquisition may be more related to the motion of space rather than the Higgs mechanism[5,6].

B. Basic Assumptions of Unified Field Theory

This paper posits that the universe consists solely of objects and space, with space moving in a cylindrical spiral motion. The physical world we perceive is a fictional representation processed by our brains, while the true geometric world of objects and space exists independently of observers. The motion of space around a stationary object relative to an observer occurs in a cylindrical spiral pattern at the speed of light **c**. This perspective emphasizes the observer's role in understanding physical phenomena and the relativity of all physical descriptions.

C. The Four Fundamental Forces and Their Unification

Unified field theory describes space surrounding any object as moving outward at the speed of light, **c**, which observers perceive as time. Mass is defined by the quantity of space per unit volume around an object,

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and electric charge represents the rate of change of mass with time. The momentum formula in unified field theory differs from classical mechanics:

$$\mathbf{p} = m(\mathbf{c} - \mathbf{v}) \tag{1}$$

Taking the time derivative yields four components of force:
1. $\mathbf{c}\frac{dm}{dt}$: electric force,
2. $\mathbf{v}\frac{dm}{dt}$: magnetic force,
3. $m\frac{d\mathbf{v}}{dt}$: gravitational/inertial force,
4. $m\frac{d\mathbf{c}}{dt}$: nuclear force.

This formulation unifies the four fundamental forces: gravitational, electromagnetic, and nuclear, with the weak force being a resultant force of electromagnetic and nuclear interactions.

II. BASIC CONCEPTS OF SPACE, OBJECTS, AND THE OBSERVER IN UNIFIED FIELD THEORY

Unified field theory posits that the fundamental components of the universe are objects and the space surrounding them. All physical phenomena and concepts are descriptions made by an observer of the motion of objects within space and the movement of space itself. Without the observer's descriptions, the only entities that truly exist in the universe are objects and space. Objects and space cannot be transformed from more fundamental elements, nor can they be transformed into each other. The essence of the universe is dualistic, not monistic.

The basic assumption of unified field theory is that space itself is constantly in motion, expanding outward from an object at a vector speed of light $\mathbf{c}$ in a cylindrical spiral pattern, which consists of rotational movement and linear movement perpendicular to the plane of rotation. This motion of space causes the relative positions of objects to change, and thus all object movement can be seen as a result of the movement of space. The motion of space itself can be described using mathematical methods from fluid dynamics and wave equations.

The geometric world exists independently of human consciousness and is more fundamental than the physical world, reflecting the relationship between objects and space. The physical world, as observed by humans, describes properties like mass, velocity, and momentum, but all these descriptions can ultimately be reduced to the state of the geometric world. The interaction between objects and space forms the basis of all physical phenomena, governed by the fundamental laws of the universe.

The physical world is a category of phenomena and relies on the observer's consciousness, while the ontological reality consists of objects and space, existing independently of observation. Unified field theory views concepts like time, displacement, mass, and charge not as intrinsic materials but as products of the movement of objects and space. The interaction between objects and space is bidirectional; objects influence the motion of space, and in turn, the movement of space affects the positions and motions of other objects. This interaction forms the basis for all fundamental forces, such as gravitational, electromagnetic, and nuclear forces.

Unified field theory emphasizes the role of the observer, as observers not only establish the framework for measurements but also influence the interpretation of these measurements. Without specifying the observer's frame of reference, descriptions of physical events may lack context and lead to misinterpretations of phenomena.

III. TIME

Definition 1 (The definition of time) *Time is the perception of an observer of the surrounding space's spiral motion at the velocity of light. Its essence is a description of space moving at the velocity of light.Therefore, the spacetime unification equation is*

$$\mathbf{r} = \mathbf{c}t \tag{2}$$

where the direction of $\mathbf{c}$ *can be understood as the direction of the observer's line of sight.* $\mathbf{r}$ *is the displacement traversed by the space moving at the velocity of light.*

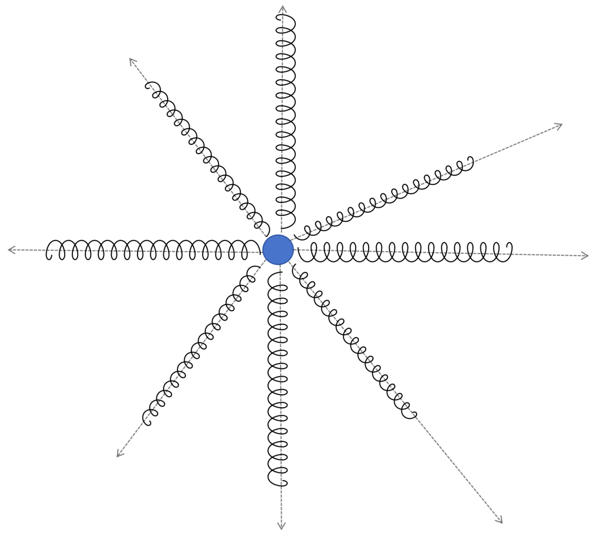


FIG. 1: The motion of space around an object

A. The isotropy of time

The isotropy of time means that regardless of the direction chosen by the observer, the passage of time remains equivalent. This property is determined by the characteristics of the observer.

B. The principle of constant speed of light

Time quantity t is directly proportional to the displacement $\mathbf{r}$ of spatial motion at speed of light $\mathbf{c}$, given by Equataion 2 where $\mathbf{c} = \frac{\mathbf{r}}{t}$ is a fraction. From elementary mathematics, we know a fraction represents division of the numerator by the denominator.

The numerator in $\mathbf{c}$, which is spatial displacement $\mathbf{r}$, and the denominator, which is time t, are essentially the same thing. They are named differently by us observers.

For example, Elbert, also known as Einstein, though two names, refers to the same person.

Thus, when the numerator of $\mathbf{c}$, spatial displacement $\mathbf{r}$, changes, the denominator of $\mathbf{c}$, time t, changes in sync because $\mathbf{r}$ and t are fundamentally the same thing, named differently by us observers.

Additionally, due to the isotropy of time—where regardless of the direction chosen by the observer, the passage of time remains equivalent—thus $\mathbf{c} = \frac{\mathbf{r}}{t}$ remains invariant, which is why the speed of light is constant.

C. Lorentz transformation

From the principle of the constancy of the speed of light, we can derive the Lorentz transformations.This is the formula that has been widely used in mainstream scientific community[7]:

$$x' = \gamma(x - vt), \quad y' = y, \quad z' = z, \quad t' = \gamma\left(t - \frac{vx}{c^2}\right) \tag{3}$$

where $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ is the Lorentz factor, and c is the speed of light. These equations describe how spatial coordinates (x, y, z) and time t transform between two inertial reference frames moving relative to each other at velocity v, ensuring the constancy of the speed of light in the framework of special relativity.

IV. FIELD

In mathematics, a field is defined as a region in which each point corresponds to a specific quantity, which can be a scalar or a vector. Unified field theory relates gravitational, electric, magnetic, and nuclear force fields to the cylindrical spiral motion of space. The weak force field is regarded as a combination of electric, magnetic, and nuclear forces rather than a fundamental field.

The unified definition of the four major physical fields is that a field is described by the displacement vector from a particle to points in the surrounding space, reflecting the degree of motion of space relative to an observer. The essence of a field is space undergoing cylindrical spiral motion, and all effects of a field can be considered as resulting from this motion of space. A field is a vector field representing different forms of cylindrical spiral motion of space, and space, particles, observers, and motion are all essential elements for defining a field.

A field can have three forms of distribution: over a volume, over a surface, or along a line. The relationships between these distributions are described by theorems in field theory, such as Gauss's theorem, Stokes' theorem, and the gradient theorem. Divergence describes the linear motion part of space, while curl describes its rotational motion.

V. MOMENTUM AND GRAVITATIONAL FIELD

In the framework of unified field theory, the mass m at point o represents the number of cylindrical spiral space displacements R emanating from point o within a solid angle of 4π at the speed of light. The gravitational field A generated around point o represents the number of space displacements passing through a Gaussian spherical surface S surrounding point o and dispersing at the speed of light.

A. gravitational field

First, we assume that a particle o is stationary relative to our observer. Any point in space p starts from point o at zero time with the vector light speed $\mathbf{c}$, moving in a cylindrical spiral along a certain direction. After time t, it reaches the position where point p is at time t'. We place point o at the origin of the Cartesian coordinate system xyz. The vector $\mathbf{R}$ pointing from point o to point p is given by the previous space-time unification equation $\mathbf{R} = \mathbf{c}t$:

$$\mathbf{R} = \mathbf{R}(x, y, z, t)$$

Note that the trajectory of point p in space is a cylindrical spiral. We can also consider the vector $\mathbf{R}$ with one endpoint at o stationary and the other endpoint p moving, causing $\mathbf{R}$ to trace a cylindrical spiral path in space.

We take the scalar length r of $\mathbf{R}$ in $\mathbf{R} = \mathbf{c}t$ as the radius and create a Gaussian surface $s = 4\pi r^2$. [In general cases, the Gaussian surface may not be a perfect sphere, but it should be continuous and without holes] surrounding particle o.

We uniformly divide the Gaussian surface $s = 4\pi r^2$ into many small pieces, and we select a small vector element ΔS where point p is located [We denote the direction of ΔS as $\mathbf{N}$, with its quantity being the surface element Δs]. We observe that there are Δn displacement vectors $\mathbf{R}$ of space points similar to p passing perpendicularly through Δs.

Note: The radius of the Gaussian surface s may not equal the scalar length of $\mathbf{R}$, but we set them equal so that the observation point p coincides with the Gaussian surface s.

Thus, the gravitational field $\mathbf{A}$ [in quantity is a] produced by point o at point p in space is:

$$a = \zeta_0 \frac{\Delta n}{\Delta s} \tag{4}$$

where ζ_0 is a constant. To describe the direction of the gravitational field $\mathbf{A}$, we mainly consider the situation around point p.

The vector displacement $\mathbf{R} = \mathbf{c}t$ perpendicular to ΔS passes through ΔS. In general, the vector displacement $\mathbf{R} = \mathbf{c}t$ may not pass perpendicularly through ΔS, but instead forms an angle θ with the normal direction $\mathbf{N}$ of the vector element ΔS.

Since point o is stationary relative to our observer and the movement of the surrounding space is uniform without any special direction, and because we are using a Gaussian surface that is a perfect sphere, under these conditions, the vector $\mathbf{R} = \mathbf{c}t$ passes perpendicularly through the vector element ΔS.

Therefore, the gravitational field $\mathbf{A}$ generated by point o at point p in the surrounding space (in vector form) can be written as:

$$\mathbf{A} = -gk\frac{\Delta n(\mathbf{R}/r)}{\Delta s}$$

where g is the gravitational constant and k is a proportional constant. Note that the direction of the gravitational field $\mathbf{A}$ is opposite to the direction of the vector $\mathbf{R}$ pointing from point o to space point p.

Suppose there are n similar spatial displacement vectors $\mathbf{R}$ around point o, radiating from point o, but any two have different directions. The physical meaning of $n\mathbf{R} = n\mathbf{R}$ indicates that the directions of n spatial displacements are the same and superimposed. Therefore, such $\mathbf{R}$ as a vector only has physical meaning when $\Delta n = 1$. However, considering the infinitesimal case, all directions of Δn can be regarded as the same.

The physical meaning of the formulas $a = \zeta_0\frac{\Delta n}{\Delta s}$ and $\mathbf{A} = -gk\frac{\Delta n(\mathbf{R}/r)}{\Delta s}$ tells us that:

On a small vector element ΔS of the Gaussian surface $s = 4\pi r^2$, the density of the space vector displacement $\mathbf{R}$ [$\mathbf{R} = \mathbf{c}t$] passing perpendicularly reflects the gravitational field strength at that location.

We express Δs in the formula $\mathbf{A} = -gk\frac{\Delta n(\mathbf{R}/r)}{\Delta s}$ using the solid angle Ω and the radius r of the Gaussian surface, i.e., $\Delta s = \Omega r^2$.

$$\mathbf{A} = -gk\frac{\Delta n(\mathbf{R}/r)}{\Omega r^2} = -gk\frac{\Delta n\mathbf{R}}{\Omega r^3}$$

If we denote a small vector element of the Gaussian surface by ds, then:

$$ds = rd\theta \cdot r\sin\theta d\phi = r^2 d\theta \sin\theta d\phi = r^2 d\Omega$$

B. Momentum

Since the concept of mass originates from Newtonian mechanics, by comparing the definition equation of the geometric form of the gravitational field in the above unified field theory

$$\mathbf{A} = -\frac{gk\Delta n\mathbf{R}}{\Omega r^3} \tag{5}$$

with Newtonian gravitational field equation [8] (page 121)

$$\mathbf{A} = -\frac{gm\mathbf{R}}{r^3} \tag{6}$$

we can derive the mass definition equation of an object at point o as:

$$m = \frac{k\Delta n}{\Omega} \tag{7}$$

The differential form is:

$$m = \frac{k\,dn}{d\Omega} \tag{8}$$

In the above equation, k is a constant. Since space can be infinitely divided, the differential of n, or dn, is meaningful.

Integrating the right-hand side of the above equation around the area between 0 and 4π:

$$m = \frac{k \oint dn}{\oint d\Omega} = \frac{kn}{4\pi} = \frac{\frac{1}{3}kn}{\frac{4\pi}{3}} = \frac{\zeta_1 n}{\Omega_V} \tag{9}$$

ζ_1 is a constant, while Ω_V represents the volume of a unit hemisphere. The physical meaning of the above formula is:

The mass m at point o represents the distribution of n spatial displacement vectors $\mathbf{R} = \mathbf{c}t$ within the solid angle 4π.4π can also be considered as three times the volume of a unit radius sphere.

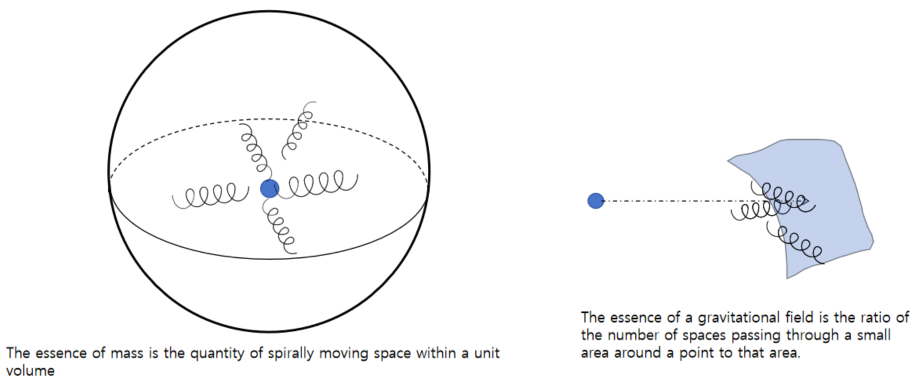


FIG. 2: The Essence of Mass and Gravitational Field

The above equation 8is the differential definition equation of mass in its geometric form. When an object starts moving with velocity v, the radius of a unit radius sphere with volume V in the direction of motion is reduced by a relativistic factor γ^{-1}, where γ is the Lorentz factor[7] given by

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}},$$

where c is the speed of light. Thus, this unit sphere Ω_V becomes an ellipsoid $\Omega_{V'}$. The volume of this ellipsoid is the volume of the unit sphere multiplied by $\sqrt{1 - \frac{v^2}{c^2}}$.Thus, the new ellipsoid $\Omega_{V'}$ has a size of $\sqrt{1 - \frac{v^2}{c^2}} \cdot \Omega_V$. However, the quantity n of the internal space of the unit sphere remains invariant under Lorentz transformations. Consequently, the mass of the object m' becomes

$$\frac{\zeta_1 n}{\sqrt{1 - \frac{v^2}{c^2}} \cdot \Omega_V}.$$

Thus,

$$m' = \frac{m}{\sqrt{1 - \frac{v^2}{c^2}}}. \tag{10}$$

Formula 10 is the formula for relativistic mass[7] and the reason for the increase in mass of a moving object.

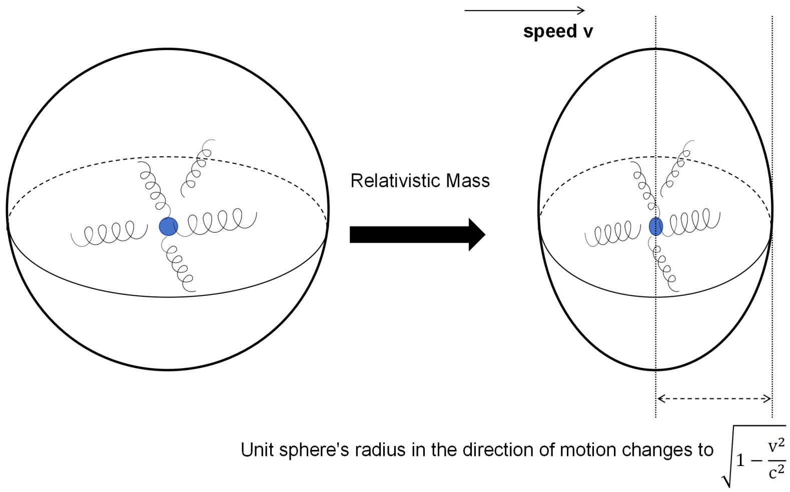


FIG. 3: relativistic mass

VI. MOMENTUM FORMULA OF A STATIONARY OBJECT

The fundamental assumption of the unified field theory posits that for any object o in the universe, when stationary relative to the observer, the surrounding space radiates outward from o in a cylindrical spiral motion at the speed of light, denoted as $\mathbf{c}$. Consider a spatial point p in the vicinity of o, which, starting at o at $t = 0$, travels at velocity $\mathbf{c}$ for a time interval t', eventually reaching p at time t''.

Assume that the space around o consists of n spatial displacements. For a given displacement vector $\mathbf{R} = \mathbf{c}t'$, we can define a solid angle Ω around o such that it contains a single spatial vector displacement $\mathbf{R} = \mathbf{c}t'$. The quantity

$$\mathbf{L} = \frac{kn\mathbf{R}}{\Omega} \tag{11}$$

represents the amount of spatial motion in the local region surrounding o, where k is a proportional constant and Ω is an arbitrary solid angle.

Taking the partial derivative of L with respect to time t' gives the rate of spatial motion in the region:

$$\frac{\partial \mathbf{L}}{\partial t'} = \frac{k\Delta n \frac{\partial \mathbf{R}}{\partial t'}}{\Omega} = \frac{k\Delta n\mathbf{c}}{\Omega}. \tag{12}$$

Since $\mathbf{R} = \mathbf{c}t'$, we use the previously defined equation for mass Equation 7 to rewrite this in terms of a stationary momentum:

$$\mathbf{p}_{\text{static}} = m_{static}\mathbf{c}, \tag{13}$$

where m_{static} represents the mass when stationary, and $\mathbf{c}$ distinguishes the velocity in this case from the moving velocity $\mathbf{c}$. The stationary momentum $\mathbf{p}_{\text{static}}$ reflects the extent of spatial motion around o when at rest.

Importantly, this formulation shows that $\mathbf{p}_{\text{static}}$ depends on the rate of change of the displacement vector $\mathbf{R}$ with respect to the solid angle Ω and time t', but is independent of the distance between points o and p. This contrasts with gravitational fields, where distance plays a role. A similar framework applies when o is in motion, as the dynamic momentum exhibits analogous properties.

VII. THE MOMENTUM FORMULA OF A MOVING OBJECT

Suppose the inertial reference frame s' moves relative to s with a constant velocity $\mathbf{v}$ (with a scalar v) along the positive direction of the x-axis in a straight line. Let point o be stationary relative to the observer in s', possessing a rest momentum $m_{static}\mathbf{c}$.

When point o moves with velocity $\mathbf{v}$ relative to the observer in s,the momentum cannot be simply written as $m\mathbf{c}$, because $\mathbf{c}$ represents the velocity of the space point p around o relative to the observer in s, not the velocity of point o itself. The momentum reflects the motion of the space around point o, not the space around the observer. Therefore, in the s frame, the velocity of point p relative to o is:

$$\mathbf{u} = \mathbf{c} - \mathbf{v} \tag{14}$$

Thus, the momentum in motion can be written as:

$$\mathbf{p}_{\text{motion}} = m\mathbf{u} = m(\mathbf{c} - \mathbf{v}) \tag{15}$$

A. Conservation of momentum

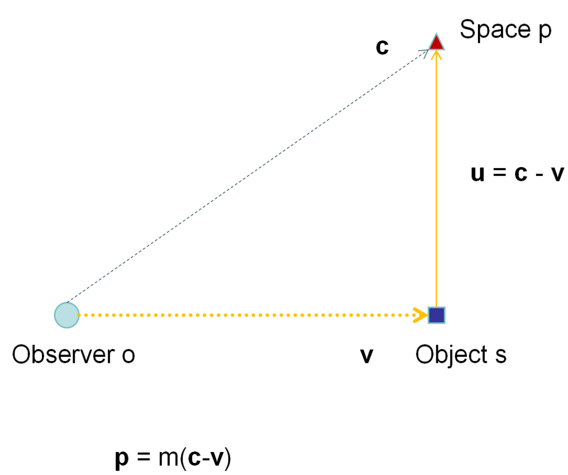


FIG. 4: Momentum

Assume that object s emits a stream of space points p, and the direction of motion of object s remains constant. We will examine the effect of different velocities of s on momentum conservation, as well as the conservation of momentum for space points p in different directions.

First, when the space point p is parallel to the direction of motion of object s, regardless of the velocity v of the object, the momentum observed by observer o remains Equation 15:

In this case, the direction of the speed of light c is always parallel to the velocity v of the object.In this scenario, while the momentum of an individual object may not be conserved due to changes in its velocity, the total momentum of the entire system remains conserved. This is because, despite the variation in the momentum of individual objects, the internal interactions within the system ensure that the net momentum does not change. This outcome aligns with the principle of momentum conservation in classical mechanics, making it a 'trivial' case in that sense.

Next, we consider the case where the motion of the space point p is perpendicular to the velocity v of the object s.

When the velocity $v = 0$, the velocity of the space point p relative to object s as observed by observer o is the speed of light vector $\mathbf{c}$. When object s moves with velocity v, although the magnitude of the velocity of the space point p relative to the observer remains the scalar speed of light c, the direction of motion rotates by an angle of $\arccos\left(\frac{|v|}{c}\right)$. Thus, the velocity of the space point p relative to object s becomes:

$$\mathbf{u} = \mathbf{c} - \mathbf{v}$$

As the velocity v of the object increases, the angle of rotation in space also increases. For instance, when v reaches half the speed of light, the space rotates by 30°; when v reaches the speed of light, the space rotates by 90°. Regardless of the changes in v, the motion of space in the direction perpendicular to v remains conserved, i.e., momentum is conserved.

To verify this, note that since $\mathbf{c} - \mathbf{v}$ is perpendicular to $\mathbf{v}$, we have:

$$|\mathbf{c} - \mathbf{v}| = \sqrt{c^2 - v^2} \tag{16}$$

Thus, the magnitude of the momentum is:

$$|\mathbf{p}_{\text{motion}}| = m_{\text{motion}}\sqrt{c^2 - v^2} = \frac{m_{\text{static}}c}{\sqrt{c^2 - v^2}} \cdot \sqrt{c^2 - v^2} = |\mathbf{p}_{\text{static}}| \tag{17}$$

This confirms the momentum conservation in the perpendicular direction. The motion in other directions can be expressed as a linear combination of the perpendicular and parallel components.The momentum conservation formula in the unified field theory demonstrates that even when the velocity of an object changes, momentum remains conserved in certain directions. Therefore, when discussing the momentum conservation of a moving object, it is important to assume that $\mathbf{c} - \mathbf{v}$ and $\mathbf{v}$ are perpendicular by default.

VIII. UNIFIED FIELD THEORY DYNAMIC EQUATION

A. General Definition of Force

Force is the degree of change in the motion state of an object (or particle) relative to an observer, or the motion of the space around the object itself, within a certain spatial range (or over a period of time).

B. The equation that unifies the four fundamental forces

We can describe the momentum of point o by the motion of a nearby space point p around it, using the Equation 15. The momentum of point o is independent of the distance between o and p, which shares similar properties with inertial forces.

Following the idea from Newtonian mechanics — that inertial force is the time derivative of momentum — we can consider the general momentum $\mathbf{p}_{\text{motion}} = m(\mathbf{c} - \mathbf{v})$ as the rate of change over time t, which reflects the four types of inertial forces in the universe. The expression is:

$$\mathbf{F} = \frac{d\mathbf{p}}{dt} = \mathbf{c}\frac{dm}{dt} - \mathbf{v}\frac{dm}{dt} + m\frac{d\mathbf{c}}{dt} - m\frac{d\mathbf{v}}{dt} \tag{18}$$

In equation 18, $(\mathbf{c} - \mathbf{v})\frac{dm}{dt}$ represents the 'Mass-acceleration force', while $m\frac{d(\mathbf{c}-\mathbf{v})}{dt}$ represents the 'Velocity-acceleration force'.

In the unified field theory, $\mathbf{c}\frac{dm}{dt}$ is interpreted as the electric field force, $\mathbf{v}\frac{dm}{dt}$ is considered the magnetic field force, $m\frac{d\mathbf{v}}{dt}$ corresponds to the inertial force in Newton's second law, which is also equivalent to gravitational force, and $m\frac{d\mathbf{c}}{dt}$ is regarded as the nuclear force. From the four fundamental forces, we obtain the four fundamental fields: the electric field $\mathbf{E}$, the magnetic field $\mathbf{B}$, the gravitational field $\mathbf{A}$, and the nuclear field $\mathbf{D}$. Together, they form a cylindrical spiral motion of space, as shown in the diagram below.

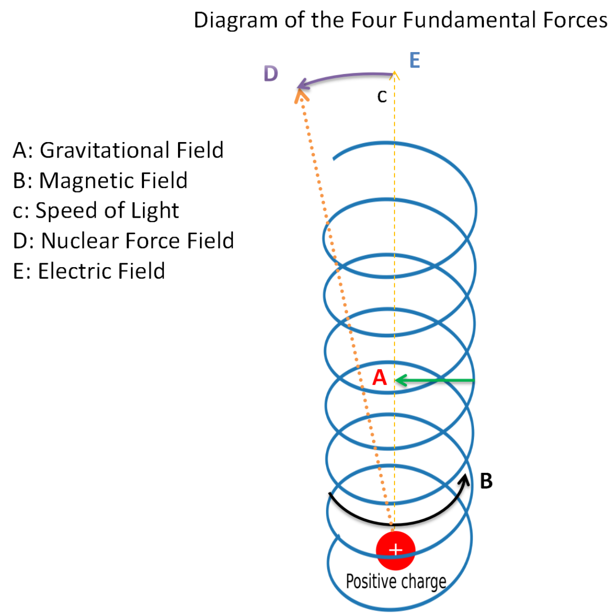


FIG. 5: Diagram of the Four Fundamental Forces

Through this formulation, the unified field theory connects the four types of inertial forces in the universe and expands the traditional definitions of momentum and force.

C. Mass-acceleration force and Velocity-acceleration force

The motion caused by the **mass-acceleration force** $(\mathbf{c}-\mathbf{v})\frac{dm}{dt}$ can also be called **mass-acceleration motion**. Mass-acceleration motion is a type of discontinuous motion. For example, when light is reflected off glass, the change in its speed happens instantaneously without requiring any time, making it discontinuous. Light is a form of mass-acceleration motion. According to the unified field theory, the reason why an electron emits a photon during its transition is that the electron loses mass under the influence of the **mass-acceleration force**, turning into a photon that moves at the speed of light. This will be discussed in detail in later chapters.

Mass-acceleration motion describes a scenario where an object's mass changes over time. When the mass reduces to zero, the object can suddenly reach the speed of light. To an observer moving along with the object, this motion appears instantaneous—they would find themselves disappearing from one location and suddenly reappearing in another.

The change in mass has a discontinuous property. The reason electromagnetic radiation is quantized in quantum mechanics is as follows: before a photon is excited, it requires a fixed amount of energy to reduce its mass to zero. If this energy is less than the required amount, the photon cannot be excited and move at the speed of light. Once the photon reaches the excitation threshold, it moves at the speed of light, and adding any more energy will have no further effect.

D. Nuclear force

The nuclear force $m\frac{d\mathbf{c}}{dt}$ is what the Standard Model refers to as the strong interaction. According to unified field theory, the weak interaction is actually a combination of electromagnetic force and the strong interaction, hence the renaming of the strong force to the nuclear force. The nuclear force arises from changes in the velocity of light. Typically, we think that the speed of light is constant, but this only refers to the magnitude of the velocity, while its direction can change. Unified field theory posits that the space around an observer moves outward in a cylindrical spiral, implying that the velocity of light also follows a spiral pattern, with its direction constantly changing. At small scales, the change in the direction of light is intense, which is why the nuclear force is extremely strong. However, at larger scales, the change in the velocity of light's direction becomes negligible, which explains why the nuclear force acts over short distances.

The nuclear force and Einstein's mass-energy equation [7] exhibit a high degree of formal consistency. We know that the definition of nuclear force is

$$m\frac{d\mathbf{c}}{dt}, \tag{19}$$

with the magnitude of the speed of light, c, being a constant, while its direction, θ, can change at any moment. To completely counteract the effects of the nuclear force, the nuclear force would need to perform work to accelerate the object to the speed of light or move it at the speed of light over a period of time. Thus, the work done by the nuclear force is:

$$W = |\int_0^T m\frac{d\mathbf{c}}{dt} \cdot c\,dt| = mc^2|\int_0^T d\theta|, \tag{20}$$

Equation explains that the energy of the nuclear force is of the same order of magnitude as the total energy possessed by the object itself.

E. Electric force and Magnetic force

In the unified field theory, $\mathbf{c}\frac{dm}{dt}$ represents the electric force, while $\mathbf{v}\frac{dm}{dt}$ represents the magnetic force. From the figure 5, we can observe the relative relationship between the magnetic force and the electric force. The magnetic force can be seen as the force in the rotational direction of the spiral motion, while the electric force is the force in the linear direction of the spiral motion. By dividing the magnitude of the electric force by the magnetic force, we get:

$$\frac{|\mathbf{F_E}|}{|\mathbf{F_B}|} = \frac{|\mathbf{c}|}{|\mathbf{v}|} \tag{21}$$

The Lorentz force is $q\mathbf{v}\times\mathbf{B}$[9] (page 212), and the electric force is $\mathbf{E}q$ [9] (page 61). Additionally, in a vacuum, the magnitudes of the electric and magnetic fields satisfy $|\mathbf{B}| = \frac{|\mathbf{E}|}{c}$[9] (page 397). This tells us that the ratio of the electric force to the magnetic force derived from the unified field theory is consistent with the ratio of the electric force to the Lorentz force in classical electromagnetism.

IX. FURTHER DISCUSSION ON GRAVITATIONAL FIELDS

We previously, as well as in V A, mentioned the definition of the gravitational field, but a deeper understanding is still needed regarding the generation and nature of the gravitational field and universal gravitation. Moreover, in V A, the discussion focused on the gravitational field in a stationary state or at a constant speed. When the velocity changes, the relativistic effects make the changes in the gravitational field more complex.

A. The essence of universal gravitation

The essence of universal gravitation lies in the changes in the motion of space between particles. "Force" is merely a description of the relative accelerated motion between objects, rather than an entity. When a stone falls towards the Earth, it is actually the space in which the stone resides that accelerates towards the center of the Earth. Regardless of the stone's size, it is the acceleration of the surrounding space that causes the stone to move toward the Earth's center. Thus, all objects have the same acceleration because the space they occupy has an acceleration directed towards the center of the Earth.

According to unified field theory, space expands outward at the speed of light and interacts with surrounding space, generating a net acceleration directed towards the Earth's center—this is the essence of gravitation. As depicted in Figure5, when space radiates from an object, the gravitational field $\mathbf{A}$ points towards the center of rotation, indicating that the gravitational field direction is consistent with the direction of space's acceleration. This is a direct manifestation of gravitational field action. Moreover, when two bundles of space moving in opposite directions meet, a portion of the space vanishes, which appears as a shortening of the distance between two objects.

The gravitational field is an expression of the acceleration of space, and this relationship is given by:

$$\mathbf{A} = \frac{\partial \mathbf{v}}{\partial t} \tag{22}$$

This equation indicates that the direction and magnitude of the gravitational field are equal to the acceleration of space. The gravitational field is not only a phenomenon within stationary space but also has wave-like properties, with the wave-like nature being the helical motion of space propagating at the speed of light. Space radiating from an object interacts with surrounding space, creating an acceleration directed towards the Earth's center, resulting in gravitational phenomena. The helical motion of space makes the gravitational field a conservative field.

The equivalence of inertial mass and gravitational mass can be explained through the gravitational field and the properties of space. Inertia represents an object's resistance to changes in acceleration, while the gravitational field represents the acceleration of the space in which the object resides. This equivalence also explains why all objects have the same acceleration under gravitational influence.

B. Lorentz transformation of the gravitational field

We assume that the object is moving with velocity $\mathbf{v}$ relative to the observer, and $\mathbf{v}$ is along the positive direction of the x-axis.By Equation 22, we have

$$\mathbf{A} = \frac{\partial \mathbf{v}}{\partial t} = \frac{\partial^2 \mathbf{r}(x,y,z)}{\partial t^2} = \frac{\partial^2 r_x}{\partial t^2}\mathbf{i} + \frac{\partial^2 r_y}{\partial t^2}\mathbf{j} + \frac{\partial^2 r_z}{\partial t^2}\mathbf{k} \tag{23}$$

In x-direction,both r_x and t must be transformed according to Lorentz transformations. Thus, we obtain:

$$A_x = \frac{\partial^2 r_x}{\partial t^2} = \frac{\gamma^{-1}\partial^2 r_x^0}{\gamma^{-2}\partial t_0^2} = \gamma A_x^0 \tag{24}$$

In $y-$ and $z-$ direction,r_y and r_z remain unaffected by Lorentz transformations, while only t undergoes the transformation. Therefore, we have :

$$A_y = \frac{\partial^2 r_y}{\partial t^2} = \frac{\partial^2 r_y^0}{\gamma^{-2}\partial t_0^2} = \gamma^2 A_y^0 \tag{25}$$

and

$$A_z = \frac{\partial^2 r_z}{\partial t^2} = \frac{\partial^2 r_z^0}{\gamma^{-2}\partial t_0^2} = \gamma^2 A_z^0 \tag{26}$$

Here $\mathbf{r^0}$ represents the position vector of the stationary object, and $\mathbf{A^0}$ represents the gravitational field in the stationary reference frame. Thus, by applying Equations 24, Equation 25, and Equation 26, and noting that $\frac{\partial}{\partial x} = \gamma \frac{\partial}{\partial x_0}$, $\frac{\partial}{\partial y} = \frac{\partial}{\partial y_0}$, and $\frac{\partial}{\partial z} = \frac{\partial}{\partial z_0}$, we have

$$\nabla \cdot \mathbf{A} = \frac{\partial \mathbf{A}}{\partial x} + \frac{\partial \mathbf{A}}{\partial y} + \frac{\partial \mathbf{A}}{\partial z} = \gamma^2 (\frac{\partial A_x^0}{\partial x_0}\mathbf{i} + \frac{\partial A_y^0}{\partial y}\mathbf{j} + \frac{\partial A_z^0}{\partial z}\mathbf{k}) = \gamma^2 \nabla \cdot \mathbf{A}^0 \tag{27}$$

and

$$\nabla \cdot \mathbf{A^0} = (1 - \frac{v^2}{c^2}) \nabla \cdot \mathbf{A}. \tag{28}$$

In this way, we can understand the effects of the object's motion on the gravitational field in various directions.

X. CHARGE AND ELECTRIC FIELD

In the unified field theory, if a particle o carries a charge q, q represents the number of R lines passing through per unit solid angle per unit time. In other words, the rate of change of mass m with respect to time t is the charge. Thus, we have the defining equation for charge:

$$q = k' \frac{dm}{dt}, \tag{29}$$

where k' is a constant.

The above is the differential defining equation of charge, which can also be considered the geometric form of the charge definition equation. This charge definition equation is only applicable to a single charged particle. For macroscopic objects, which contain many positive and negative charge particles, this equation cannot be directly applied, because most of the positive and negative charges in macroscopic objects cancel each other out.

Coulomb's law [9] (page 60) describes the interaction between charges as an inverse square law, which is very similar in form to the law of universal gravitation. The reason for this similarity can be well understood from the equation $q = k' \frac{dm}{dt}$. Since charge is defined as the rate of change of mass with respect to time, Coulomb's force [9] (page 60) takes on a form very similar to that of gravitational force. The fundamental reason behind this similarity lies in the distribution of space on a spherical surface. Gravitational force reflects the number of spatial units per unit area on a spherical surface, whereas Coulomb's force reflects the rate of change of these spatial units per unit area over time. This underlying reason explains why both forces follow the same inverse square law structure.

According to the classical electromagnetism formula [9] (page 61) for the electric field of a point charge:

$$\mathbf{E} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{\mathbf{r}} \tag{30}$$

Using Equation 29, we substitute this into the classical electric field equation:

$$\mathbf{E} = \frac{k'}{4\pi\epsilon_0 r^2} \frac{dm}{dt} \hat{\mathbf{r}} \tag{31}$$

This equation represents the electric field as a function of the rate of change of mass with respect to time.

A. The Relativistic Invariance of Charge

In practice, experiments have observed that electric charge does not exhibit relativistic effects [10]. When the particle at point o is stationary relative to the observer, it carries a charge q. According to Equation 29,it is easy to see that when point o moves with velocity v relative to the observer, both the mass m and the time t increase by a relativistic factor of $(1 - \frac{v^2}{c^2})^{-\frac{1}{2}}$ [7]. Therefore, q remains unchanged.

B. Atomic Model

The mass of the electron changes cyclically rather than increasing or decreasing continuously, which is why significant mass changes are not observed in experiments. Space continuously flows from positively charged atomic nuclei, and due to its small mass, an electron loses its mass and moves at the speed of light under an anti-gravitational field, becoming a photon. This photon may then be recaptured by the space flowing from the nucleus, regaining mass and becoming an electron again. The captured photon can be from the environment rather than the original electron.

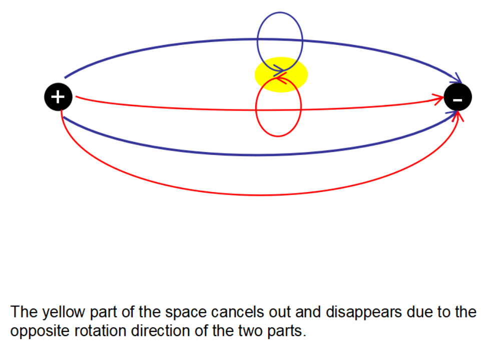
An electron gains mass only momentarily, whereas losing mass is a continuous process, resulting in a negative time derivative of mass. This mechanism explains electron transitions and photon release, and why the electron carries a negative charge. Correspondingly, this also explains why atomic nuclei carry a positive charge.

Furthermore, the space around negatively charged particles continuously decreases, so their spin direction is exactly opposite to the rotation direction of space. As shown in Figure 5, the rotation direction of space is precisely the direction of the magnetic field. Therefore, the spin of negatively charged particles is opposite to the direction of the magnetic field they produce. Similarly, the spin direction of positively charged particles aligns with the direction of the magnetic field they produce. Additionally, the reason electrons and other microscopic particles exhibit spin is due to the cylindrical spiral motion of space. The intrinsic spin of these particles originates from the rotational nature of space itself. This rotation of space, combined with the cyclic fluctuations in the electron's mass, leads to highly uncertain motion[11], which manifests as a probabilistic electron cloud[12]. A more detailed explanation of the atomic model and wave-particle duality will be discussed in subsequent sections.These conclusion is consistent with known phenomena[13,14].

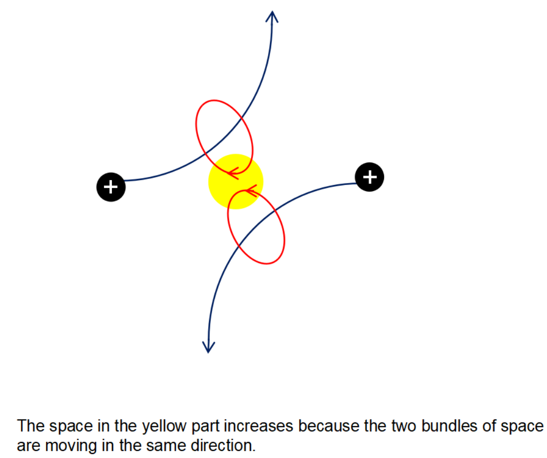
C. Positive and negative charge model

In unified field theory, the reason a particle carries charge is that the space around the particle moves in a cylindrical helical pattern. The space around a positive charge radiates outward at the speed of light, while the space around a negative charge converges inward at the speed of light. Overall, this results in the space around a positive charge appearing to converge toward the negative charge at the speed of light, which indicates that electric field lines are real—they represent the motion of space from the positive charge to the negative charge at the speed of light.

The right-hand rule can be used to explain the direction of space's rotation around both positive and negative charges: for a positive charge, the direction in which the fingers curl represents the direction of space's rotation, and the thumb points in the direction of the outward radiating velocity. For a negative charge, the fingers still indicate the direction of space's rotation, but the thumb points in the direction of the inward converging velocity. Thus, both positive and negative charges are surrounded by space that follows a right-handed helical structure.



(a) Encounter of a positive charge and a negative charge.



(b) Encounter of a positive charge and another charge.

FIG. 6: Charges encounter charges

The reason for the attraction between positive and negative charges lies in the cylindrical spiral motion of the space around them. As shown in Figure 6a, the radial part of the space moves at the speed of light, starting from the positive charge and ending at the negative charge. The rotational part of the space also moves from the positive charge to the negative charge. Where the rotational parts meet, they cancel each other out due to their opposite directions, causing a reduction in the amount of space between them, which manifests as the attraction between the charges. Figure 6b shows two equal positive charges approaching each other. The rotational parts of the space, where they come into contact, have the same direction of motion, causing the amount of space to increase. As a result, the space between the two positive charges expands, leading to a tendency to move apart, manifesting as mutual repulsion. The reason for the repulsive force between negative charges is the same as that between positive charges. Both are caused by the same direction of motion in the surrounding space, which leads to an increase in the amount of space and a tendency for the charges to move apart.

D. Definition equation of the magnetic field

In electrodynamics, when a charged particle moves with velocity $\mathbf{v}$ relative to an observer in vacuum, due to relativistic effects, the observer will experience a magnetic field related to the electric field. Relativity electrodynamics[9] (page 462) has pointed out that this magnetic field can be expressed as:

$$\mathbf{B} = \frac{\mathbf{v} \times \mathbf{E}}{c^2}. \tag{32}$$

This result highlights the relativity of electromagnetic fields, meaning that in different reference frames, the manifestations of electric and magnetic fields can differ, with the direction and magnitude of the magnetic field depending on the relative motion between the observer and the charge. Unified field theory inherits this equation and gives it a deeper meaning. In fact, when we say that the charge is moving at a velocity $\mathbf{v}$, we can reinterpret this as the electric field generated by the charge moving at velocity $\mathbf{v}$. The motion of the electric field arises because the space in which the electric field exists is itself moving at velocity $\mathbf{v}$. Thus, the equation 32 can be reinterpreted as follows: the magnetic field at a given point in space is the cross product of the velocity of space itself and the electric field at that point, divided by the square of the speed of light.

In this way, the definition of the magnetic field is no longer limited to the motion of charges but is instead derived from the motion of space itself, revealing a deeper connection between space and the electromagnetic field.Thus,we refer to Equation 32 as the definition equation of the magnetic field.

XI. MUTUAL CONVERSION BETWEEN ELECTRIC FIELDS, MAGNETIC FIELDS, AND GRAVITATIONAL FIELDS

A. Generation of an Electric Field Due to Changes in the Gravitational Field

By comparing Equations 7, Equation 5, and Equation 31, we derive the equation for the generation of an electric field from a changing gravitational field:

$$\mathbf{E} = -\frac{k'}{4\pi\epsilon_0 g}\frac{\partial \mathbf{A}}{\partial t}. \tag{33}$$

By combining the constants, we obtain:

$$\mathbf{E} = -f\frac{\partial \mathbf{A}}{\partial t}, \tag{34}$$

where f is a constant.The electric field represents the rate of change of space per unit area per unit time on a spherical surface, while the gravitational field represents the total amount of space within a unit area on the spherical surface. This means that the time derivative of the gravitational field has a simple and direct correspondence with the electric field, which is precisely what Equation 34 indicates. When an object moves at a constant velocity v along the positive direction of the x-axis relative to us, according to Equations 28 and noting that

$$E_x = -f\frac{\partial A_x}{\partial t}, \tag{35}$$

and

$$v\frac{\partial \mathbf{A}(x-vt,y,z)}{\partial x} = -\frac{\partial \mathbf{A}(x-vt,y,z)}{\partial t}, \tag{36}$$

we have

$$\begin{aligned}
\nabla\cdot\mathbf{A^0} &= \left(1-\frac{v^2}{c^2}\right)\nabla\cdot\mathbf{A} \\
&= \nabla\cdot\mathbf{A} - \frac{v}{c^2}v\frac{\partial A_x}{\partial x}\mathbf{i} - \frac{v^2}{c^2}\left(\frac{\partial A_y}{\partial y}\mathbf{j} + \frac{\partial A_z}{\partial z}\mathbf{k}\right) \\
&= \nabla\cdot\mathbf{A} + \frac{v}{c^2}\frac{\partial A_x}{\partial t}\mathbf{i} - \frac{v^2}{c^2}\left(\frac{\partial A_y}{\partial y}\mathbf{j} + \frac{\partial A_z}{\partial z}\mathbf{k}\right) \\
&= \nabla\cdot\mathbf{A} - \frac{v}{fc^2}E_x\mathbf{i} - \frac{v^2}{c^2}\left(\frac{\partial A_y}{\partial y}\mathbf{j} + \frac{\partial A_z}{\partial z}\mathbf{k}\right)
\end{aligned} \tag{37}$$

Equation 37 shows that the gravitational field in motion under Lorentz transformation gives rise to a term related to the electric field.

B. Generation of a Magnetic Field by a Changing Gravitational Field

By substituting Equation 34 into Maxwell's equation[9] (page 337)

$$\mu_0\mathbf{J} + \frac{1}{c^2}\frac{\partial \mathbf{E}}{\partial t} = \nabla\times\mathbf{B}, \tag{38}$$

we obtain:

$$\frac{\partial^2 \mathbf{A}}{\partial t^2} = -\frac{c^2}{f}\left(\nabla\times\mathbf{B}\right) + \frac{\mu_0 c^2\mathbf{J}}{f}. \tag{39}$$

This equation demonstrates that a changing gravitational field can generate a magnetic field.

C. Magnetic Potential and Gravitational Field

First, we assume that the curl of the static gravitational field is zero, i.e.,

$$\nabla \times \mathbf{A^0} = 0 \tag{40}$$

When the gravitational field moves relative to the observer along the x-axis with a velocity v, both the field itself and the operator for taking the partial derivative must satisfy the Lorentz transformation.Equation 40 can be written in component form, this becomes:

$$\frac{\partial A_z^0}{\partial y_0} - \frac{\partial A_y^0}{\partial z_0} = 0, \quad \frac{\partial A_x^0}{\partial z_0} - \frac{\partial A_z^0}{\partial x_0} = 0, \quad \frac{\partial A_y^0}{\partial x_0} - \frac{\partial A_x^0}{\partial y_0} = 0 \tag{41}$$

Now, considering the relativistic transformation of the gravitational field, we have:

$$\frac{\partial A_z^0}{\partial y_0} - \frac{\partial A_y^0}{\partial z_0} = \frac{\partial A_z}{\gamma^2 \partial y} - \frac{\partial A_y}{\gamma^2 \partial z} = \frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} = 0 \tag{42}$$

where $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ is the relativistic factor, and $\frac{\partial}{\partial y} = \frac{\partial}{\partial y_0}$, $\frac{\partial}{\partial z} = \frac{\partial}{\partial z_0}$,$\frac{\partial}{\gamma \partial x} = \frac{\partial}{\partial x_0}$.

From Equation 24, 26 we get:

$$\frac{\partial A_x^0}{\partial z_0} - \frac{\partial A_z^0}{\partial x_0} = 0 \tag{43}$$

Equation 43 leads to:

$$\frac{\partial A_x}{\gamma \partial z} - \frac{\partial A_z}{\gamma^3 \partial x} = 0 \tag{44}$$

Notice that $\frac{1}{\gamma^2} = 1 - \frac{v^2}{c^2}$, we have:

$$\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} = -\frac{v^2}{c^2} \frac{\partial A_z}{\partial x} \tag{45}$$

Since Equation 36, we have:

$$\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} = \frac{v}{c^2} \frac{\partial A_z}{\partial t} \tag{46}$$

Similarly, using $\frac{\partial A_y^0}{\partial x_0} - \frac{\partial A_x^0}{\partial y_0} = 0$ and the relativistic transformation of the gravitational field, along with $\frac{\partial}{\gamma \partial x} = \frac{\partial}{\partial x_0}$, we obtain:

$$\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = -\frac{v}{c^2} \frac{\partial A_y}{\partial t} \tag{47}$$

From the Equation 34:

$$E_x = -f \frac{\partial A_x}{\partial t}, \quad E_y = -f \frac{\partial A_y}{\partial t}, \quad E_z = -f \frac{\partial A_z}{\partial t} \tag{48}$$

We can derive the following relations:

$$\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} = 0, \quad \frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} = -\frac{v}{c^2}\frac{E_z}{f}, \quad \frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = \frac{v}{c^2}\frac{E_y}{f}. \tag{49}$$

From Equation 32, we know:

$$B_x = 0, \quad B_y = -\frac{v}{c^2}E_z, \quad B_z = \frac{v}{c^2}E_y \tag{50}$$

From this, we obtain:

$$\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} = \frac{B_x}{f}, \quad \frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} = \frac{B_y}{f}, \quad \frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = \frac{B_z}{f} \tag{51}$$

Combining the above equations, we derive the relationship between the curl of the gravitational field A and the magnetic field B:

$$\nabla \times \mathbf{A} = \frac{\mathbf{B}}{f} \tag{52}$$

Taking the partial derivative of both sides of Equation 52 with respect to t, and substituting Equation 34, we obtain the Maxwell equation[9] (page 337):

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \tag{53}$$

Equation 52 indicates that there is an extremely simple and direct correspondence between the gravitational field and the magnetic potential [9] (page 243) in electrodynamics. In other words, the magnetic potential is not just a mathematical tool; its essence is the gravitational field. In quantum mechanics, the famous Aharonov-Bohm effect [15] shows that the phase of an electron's wave function is influenced by the electromagnetic potential in space, regardless of whether an electromagnetic field is present. Through Equation 52, the unified field theory provides a perfect explanation for the Aharonov-Bohm effect, suggesting that the electron's motion is essentially affected by the gravitational field.

D. Changing Electromagnetic Fields Generate Gravitational Fields

We take the partial derivative of both sides of Equation 32 with respect to t and substituting Equation 22 then we have

$$\frac{\partial \mathbf{B}}{\partial t} = \frac{\mathbf{A} \times \mathbf{E}}{c^2} + \frac{\mathbf{v}}{c^2} \times \frac{\partial \mathbf{E}}{\partial t} \tag{54}$$

The equation 54 indicates that a changing magnetic field can not only generate an electric field but also accelerate the movement of space itself, thus create a gravitational field. Moreover, as shown in Figure 5, at a given moment, the electric field, magnetic field, and gravitational field are mutually perpendicular to each other. However, when viewed as a whole, the electric field and gravitational field surrounding the changing magnetic field are aligned in the same direction and adhere to the right-hand rule (with the thumb and fingers indicating the rotational relationship). This means that when the magnetic field changes, the resulting electric field and gravitational field are co-directional. Based on this, we can infer that an accelerating positive charge generates a gravitational field in the direction opposite to its acceleration vector. This phenomenon is consistent with Lenz's law[9] (page 31). Lenz's law states that the direction of the induced current always acts to oppose the change in the magnetic field that causes it. Similarly, the gravitational field here acts to counter the acceleration, opposing the direction of motion. [9] (page 31)

XII. WAVE-PARTICLE DUALITY

Humanity initially believed that light consisted of tiny particles, a view proposed by Newton[16]. However, Thomas Young's double-slit experiment demonstrated that light exhibits wave-like properties [17], and subsequently, Maxwell proposed that light is an electromagnetic wave[2]. These ideas dominated the mainstream in the 19th century, establishing the wave theory of light[18]. By the early 20th century, Einstein's photoelectric effect provided evidence of the particle nature of light[19], thereby leading to the development of quantum mechanics. This, however, raised the question of why light behaves as both a wave and a particle[20].

The unified field theory suggests that an electric charge moving in uniform linear motion generates a uniform magnetic field, while an accelerating electric charge generates a varying magnetic field. These variations in the magnetic field can produce not only an electric field but also a gravitational field. For a negatively charged particle undergoing accelerated motion, the changing electric and magnetic fields can create an anti-gravitational field, which cancels out the electron's mass, effectively reducing it to zero.

The wave nature of light can be interpreted as arising from the inherent oscillation of space, whereas the particle nature of light is due to the fact that photons are essentially electrons that have lost their mass. In the double-slit experiment, the excitation of photons is, in reality, a process that affects the surrounding space, causing certain electrons to lose their mass, which leads to the interference pattern observed. This interference arises from the inherent oscillation of space itself. Even if only one photon is excited, the oscillation of space will still produce interference. Although the energy within the space alone is insufficient to excite a photon, the energy present in the screen combines with the residual energy in the space to create interference fringes. These interference fringes are not formed by the originally excited photons but are a result of the oscillation of space.

As discussed in Section VIII C, the quantization of photon energy can be explained by the fact that a specific amount of energy is required for an electron to lose its mass. If the electron has already lost its mass, applying additional energy beyond this threshold will not excite it further. Only an integer multiple of this specific energy can excite a corresponding number of electrons, thereby forming photons. This explains the fundamental reason for the quantized nature of photon energy.

XIII. EXPERIMENT

A. Objective

The objective of this experiment is to verify the hypothesis of unified field theory that changing electromagnetic fields can generate gravitational fields. Specifically, two experiments were conducted: (1) accelerated positive charges generating a gravitational field in the opposite direction as acceleration, and (2) varying magnetic fields generating a vortex-like gravitational field.

B. Materials and Setup

Two experimental setups were designed. In the first setup, two unconnected copper wires (diameter: 0.8 mm, length: 90 cm) were placed parallel with a 6 cm separation, covered by a plexiglass tube. A lightweight, thin plastic plate (4 cm $\times$ 11 cm, thickness: 0.15 mm) was suspended on the plexiglass tube without direct contact. The setup was powered by a high-voltage DC source (up to 50 kV), with soft silicone tubing (outer diameter: 3 mm, inner diameter: 1 mm) used for insulation. In the second setup, a polyethylene ball (mass: 0.35 g) was suspended in a vacuum chamber (diameter: 10 cm). Two silicone-coated coils (diameter: 8 cm, height: 12 cm) were placed at the top and bottom of the chamber, each connected to the positive and negative terminals of a high-voltage pulsed DC power source (52 V input, 100 kV pulsed output).

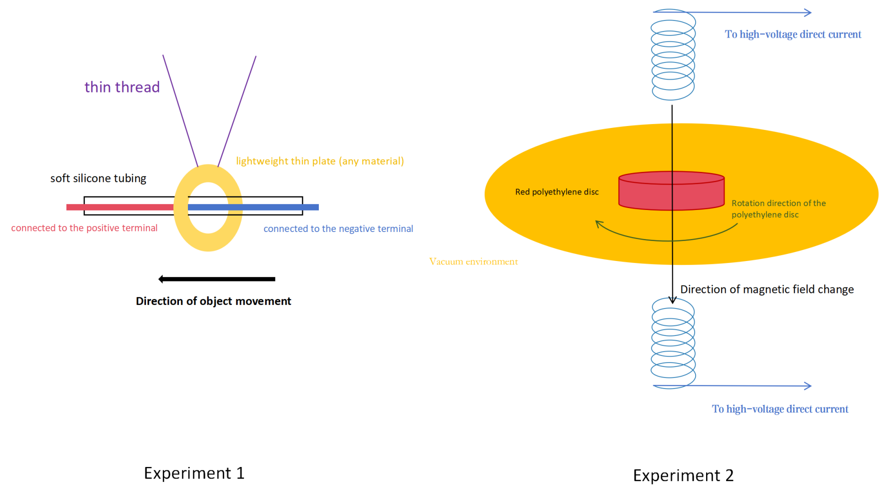


FIG. 7: Experiment

C. Experimental Procedure

In the first experiment:
1) the two copper wires were connected to the positive and negative terminals of the high-voltage DC power source, and the plastic plate was suspended between the wires without direct contact;
2) the power source was activated, and the plastic plate was observed moving towards the positive terminal, indicating the presence of a gravitational field in the opposite direction as the electric field;
3) the polarity was reversed, and the movement of the plate towards the positive terminal was observed again;
4) to minimize ion wind and electrostatic effects, the plexiglass tube was replaced with soft silicone tubing.

In the second experiment:
1) the polyethylene ball was suspended inside the vacuum chamber between two silicone-coated coils, which were connected to the positive and negative terminals of the pulsed DC power source;
2) the power source was activated, causing the ball to rotate inside the chamber;
3) when the power source was turned off, the rotation of the ball increased, indicating a vortex-like gravitational field generated by the changing magnetic field.

D. Results and Discussion

In the first experiment, the plastic plate consistently moved towards the positive terminal upon activation of the high-voltage source, regardless of polarity. This suggests that accelerated positive charges generate a gravitational field in the same direction as the electric field. Replacing the plexiglass tube with soft silicone tubing minimized external interference from ion wind and electrostatic effects, yielding more reliable results.

In the second experiment, the polyethylene ball began rotating when the pulsed DC power source was turned on. Upon turning off the power source, the rotation speed increased. This supports the hypothesis that varying magnetic fields can generate a vortex-like gravitational field, leading to rotational motion in objects placed within the field.

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