A New Perspective on the Speed of Light: A Feasible Approach to Unified Field Theory and Fundamental Physics

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Abstract

This paper introduces a novel hypothesis that explores the fundamental nature of our physical universe by reexamining the interactions between gravitational, electric, magnetic, and nuclear forces. Through a deep investigation of fields and forces, this hypothesis aims to redefine and expand upon existing physics laws and equations. The study presents mathematical proofs, evidence from nature, and relevant experiments to support this unified approach. The new perspective includes reevaluating the speed of light and its role in connecting time and space within the framework of a Unified Field Theory. This theory proposes a more comprehensive understanding of both micro and macroscopic phenomena, potentially addressing inconsistencies in current theories and offering insights into the core structure of the universe.

Keywords: Photon, Geometry, Causality, Space, Motion, Field

Disclaimer

The ideas in this paper are based on a Unified Field Theory that aims to combine different physical phenomena. They are theoretical and may conflict with existing knowledge. These ideas should be seen as part of an ongoing exploration in theoretical physics, and the experimental evidence supporting the Unified Field Theory is still under investigation. Therefore, this paper offers a speculative perspective rather than definitive proof.

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Contents

1 Motivation

The Photon Model calls for a re-examination of the fundamental assumptions of our reality. This approach aims to address the inconsistencies in current theories and achieve a more comprehensive understanding of the core concepts of the entire universe, whether on a micro or macroscopic scale. It could also potentially solve many problems in our physical world. The development process of the theory is further supported by the mathematical foundations, which serve as a truthful language. We believe that once this hypothesis is verified, the future will be within our grasp.

2 Introduction

2.1 Background: Grand Unified Theory (GUT)

Classic Theory

- **James Clerk Maxwell** unified electricity and magnetism into electromagnetism in 1864.
- **Albert Einstein** extended Maxwell's work, leading to special relativity (unifying space and time) and general relativity (describing gravity with spacetime curvature).
- **Hermann Weyl** and **Theodor Kaluza** expanded these ideas with concepts like gauge fields and extra dimensions.
- **Oscar Klein** proposed in 1926 that the fourth spatial dimension could be curled up into a small, unobserved circle, contributing to Kaluza–Klein theory.
- Einstein and others, including **Marie-Antoinette Tonnelat** and **Mendel Sachs**, pursued classical unified field theories incorporating electromagnetism, gravity, and nuclear forces.

Modern Progress

- **Sheldon Glashow**, **Abdus Salam**, and **Steven Weinberg** developed the electroweak theory, unifying the weak force with electromagnetism using the Higgs mechanism.
- The discovery of weak neutral currents in 1973 and the production of W and Z bosons in 1983 confirmed this theory, leading to Nobel Prizes for Glashow, Salam, Weinberg (1979), and **Carlo Rubbia** and **Simon van der Meer** (1984).
- Further unification efforts led to the proposal of Grand Unified Theories (GUTs) like the **Georgi–Glashow model**.
- **Gerardus 't Hooft** showed the Glashow–Weinberg–Salam electroweak interactions to be mathematically consistent.
- GUTs predict phenomena such as proton decay, though this remains experimentally unconfirmed, with a lower bound of 10^{35} years for the proton's lifetime.

2.2 Basis

The only issue we must address is finding evidence of the gravitational field's relationship with other fundamental forces.

If gravitational force also follows the uncertainty principle, like the other fundamental forces, then, as the distance between particles decreases, especially when it is smaller than the Compton wavelength, the uncertainty in momentum increases. This increase in momentum uncertainty results in a corresponding increase in energy, given the relationship between momentum and energy. Taking into account the equivalence of mass and energy through $E = mc^2$, this suggests that the gravitational force on an object is stronger than previously believed.

$$F_{\text{gravity}} = \frac{Gm_1m_2}{R^2} \tag{1}$$

Since $m = \frac{E}{c^2}$, we can rewrite the gravitational force equation as:

$$F_{\text{gravity}} = \frac{GE_1E_2}{c^4R^2} \tag{2}$$

Now, the term c^4 appears in the equation. We know that energy is given by:

$$E = \sqrt{m^2c^4 + p^2c^2} \tag{3}$$

For large momentum, this simplifies to $E = pc$. According to the uncertainty principle:

$$\Delta x \Delta p \geq \frac{\hbar}{2} \tag{4}$$

We can approximate p as $p \sim \frac{\hbar}{R}$, where the tilde ($\sim$) indicates an order of magnitude estimation, replacing Δp with p and Δx with R.

Substituting this into the gravitational force equation, we obtain:

$$F_{\text{gravity}} = \frac{G\hbar^2}{c^2R^4} \tag{5}$$

If gravity exhibits quantum effects, it would follow an inverse fourth power law:

$$F \propto \frac{1}{R^4} \tag{6}$$

Next, we consider the conditions under which the gravitational force equals the electromagnetic force:

The Coulomb Force is given by:

$$F_{\text{electromagnetic}} = \frac{kq_1q_2}{R^2} \tag{7}$$

This can be written as:

$$F_{\text{electromagnetic}} = \frac{\hbar c q_1q_2}{R^2} \tag{8}$$

Given that charge is dimensionless and its numerical value would need redefinition in this context, the dimensionless nature of charge is not crucial here.

Thus, it simplifies to:

$$F_{\text{electromagnetic}} = \frac{\hbar c}{R^2} \tag{9}$$

Recalling that $F_{\text{gravity}} = F_{\text{electromagnetic}}$:

$$\frac{G\hbar^2}{c^2 R^4} = \frac{\hbar c}{R^2} \tag{10}$$

Solving this equation for R, we find:

$$R = \sqrt{\frac{\hbar G}{c^3}} = 1.616 \times 10^{-35} \text{ meters} \tag{11}$$

This is the **Planck Length**. At this scale, the strength of the gravitational force equals that of the electromagnetic force, providing a basis for the unification of the four fundamental forces.

2.3 Suggestions from Standard Model

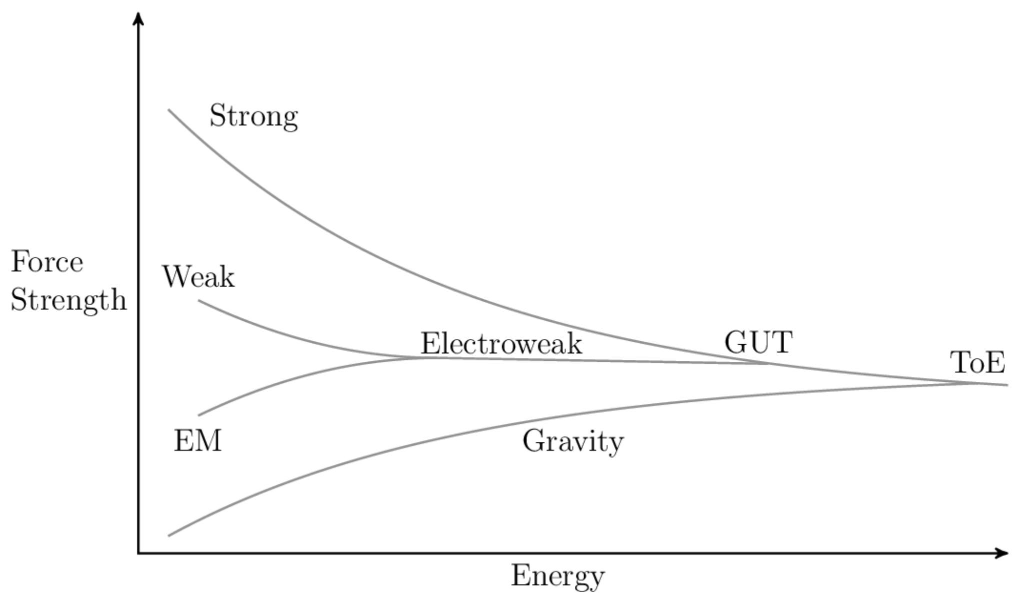


Figure 1: Energy scales for the unification of all four fundamental forces [1].

Vacuum polarization, asymptotic freedom, and quantum foam energy represent the four fundamental interactions whose strengths converge to a common point to varying degrees, as illustrated in Figure **??**.

However, several important issues need to be addressed:

First point: When gravity is not considered, the weak and strong interactions present significant challenges. As shown in Figure 2, the re-normalization process in quantum field theory does not perfectly converge the coupling constants of the three fundamental interactions to a single point; instead, they deviate slightly.

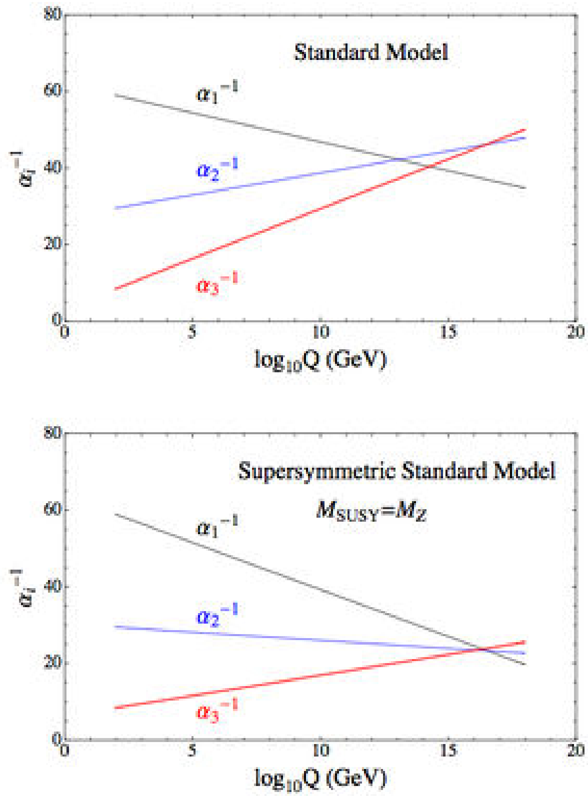


Figure 2: Grand unified theories [2].

Second point: In Figure 2 and **??** showing that even though subsequent supersymmetric theories have corrected this deviation and brought the constants closer to a single point, no experimental evidence has yet confirmed this theory. The unified energy predicted by the theory is ($\Lambda_{\text{unified}} \approx 16,000,000$ joules), which is roughly equivalent to the daily energy intake recommended for an adult male by nutritionists. Although this amount of energy might seem small, accelerating elementary particles to this energy level is a formidable challenge. Currently, the energy achieved by particle accelerators as of 2021 is $E_{\text{proton}} \approx 0.00000104$ joules, which is vastly different from the energy required for an adult who needs to consume daily. To reach this energy level, a particle accelerator would need to be as large as the radius of the Milky Way, making it practically impossible on Earth. Reaching the Planck energy, which is $\Lambda_{\text{Planck}} \approx 1,956,100,000$ joules, is even more unrealistic.

Third point: A more direct approach would be to demonstrate proton decay, as predicted by the grand unified theory and shown in Figure4. Unfortunately, experiments have not yet observed this phenomenon, which would violate baryon number symmetry.

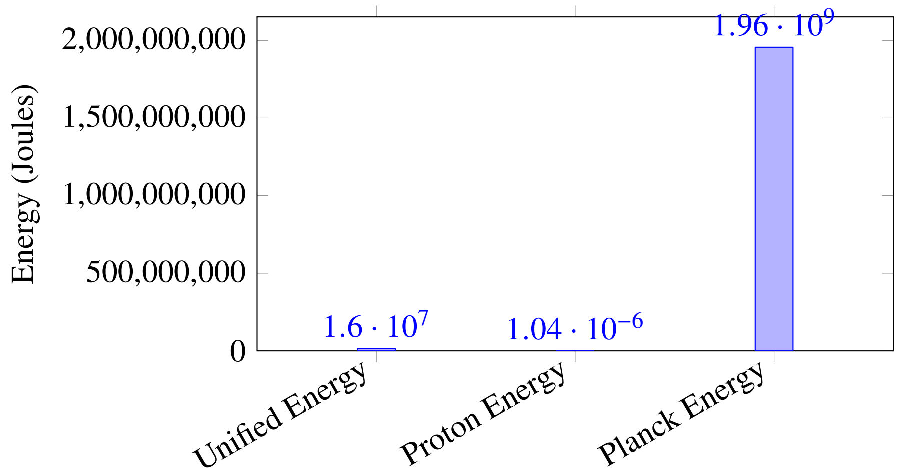


Figure 3: Comparison of Energy Scales

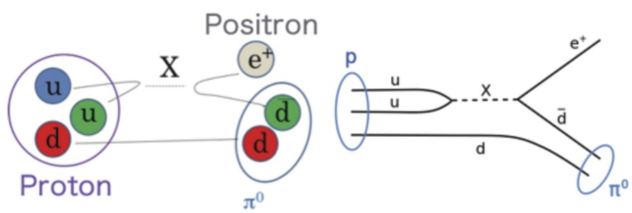


Figure 4: Illustration of positron decay [3].

3 Frameworks

The Grand Unified Theory (GUT) suggests that at a microscopic level, there may be a relationship between electromagnetic force and gravitational force. Now, we are introducing a new hypothesis called the Unified Field Theory, which could be a reasonable solution to extend the ideas from the GUT. However, within this framework, we need to redefine the physical concepts and ideas that we have established so far in Classical and Modern Physics. We also need to correct some of our assumptions. This requires some knowledge of geometry and casualties as well.

3.1 The Universe

3.1.1 Basic Structure: Dualism

The universe is composed of objects and space. These two components exist independently of observers, and nothing else coexists with them. There is no conversion between objects and space, and they are the fundamental constituents of the universe. All other phenomena, such as time, mass, velocity, etc., are mere descriptions by observers of the motion of objects within space.

3.1.2 Relationship Between Geometry and Physics

The **geometric world** is a simplified description of objects and space, focusing on size, shape, and direction. It reflects the fundamental structure of the universe. The **physical world** describes the complex motion of objects within space, often involving dynamic phenomena. Without observers, the physical world would not exist, as it is derived from the human interpretation of motion and change. Geometry, being more fundamental, aligns closely with the true nature of the universe, while physics is a more intricate extension, focused on the description of motion.

3.1.3 Helical Motion Law of the Universe

Everything in the universe, from particles like electrons and photons to massive celestial bodies such as planets and galaxies, follows a helical motion. This includes space itself, which moves in a cylindrical helical pattern. This helical motion is a core principle of the universe, explaining the movement of all objects. The **perpendicularity principle** states that at every point in space, three mutually perpendicular lines can be drawn. These lines correspond to the three-dimensional helical motion in space.

3.1.4 The Infinity of the Universe and the Limitation of the Big Bang Theory

The universe is infinite, with no beginning and no end. Both space and objects exist infinitely. The concept of time is merely an observer's description of motion within space. The Big Bang theory may explain local phenomena, but it does not account for the entire universe. The idea that the universe began with the Big Bang is a misconception.

3.1.5 Cosmic Expansion and the Motion of Space

A major evidence supporting the modern Big Bang theory is the observation that space is expanding relative to any observer, with distant galaxies moving away from us. The true reason for this expansion, according to the unified field theory, is that for any object in the universe, including any observer, the space surrounding them expands outward from the object at light speed in a cylindrical helical pattern.

The stars and galaxies within this space are also moving away from the observer, driven by this expansive motion of space itself. This helical motion of space creates the observed phenomenon of cosmic expansion.

3.1.6 Why Don't the Moon and Sun Move Away From Us at Light Speed?

The question arises as to why celestial bodies like the Moon and the Sun do not appear to be moving away from us at the speed of light. The reason lies in the initial state of motion of these bodies relative to the observer.

For instance, the Earth has been stationary relative to the observer (ourselves) from the beginning. The Moon, similarly, has been in an initial state that is nearly stationary relative to us (especially when compared to the speed of light). Thus, these nearby objects do not exhibit the fast-moving behaviour that distant galaxies do.

3.1.7 Distant Stars Moving Away Faster

The farther away a celestial body is from us, the faster it appears to be moving away. This is because those distant stars and galaxies were not in the same initial state of rest relative to the observer as closer bodies like the Moon and Sun. Hence, they are observed to recede at much faster speeds, approaching the speed of light.

The initial motion state of objects in relation to the observer is a key factor in determining how fast they are observed to be moving away, especially in the context of cosmic expansion.

3.2 Matter

3.2.1 Definition of Matter

Matter is defined as anything that exists independently of the observer. In the universe, matter is composed of objects and space. Other concepts like energy, time, or fields are not real entities but rather descriptions of motion. They do not exist outside of the observer's interpretation.

3.2.2 Rejection of Energy and Fields as Matter

Energy and time are not components of matter. They are effects or descriptions of the motion of objects and space. Fields, similarly, are not substances. Instead, fields are the result of the movement of particles or space itself. The unified field theory posits that fields are simply effects of spatial movement.

3.2.3 Interaction Between Objects and Space

Objects interact with one another through space. Objects cause space to move, which in turn affects other objects. This interaction explains the forces in the universe, such as gravity and electromagnetism. The cause-and-effect relationship between objects and space is mutually dependent; space moves because of objects, and objects move because of the space around them.

3.2.4 The Emergence of Physical Concepts

All physical concepts such as time, mass, momentum, and force are derived from the observer's perception of motion. Without objects and space, these concepts do not exist. Matter cannot be created or destroyed, and no more fundamental entity can define it. Objects can change forms, but their existence is eternal.

3.3 Space

3.3.1 Space as an Independent Entity

Space exists independently of observers. Whether or not there is an observer, space continues to exist and interact with objects. Space is infinite and continuous, with the ability to store infinite information. Any finite region of space can contain the entire history and future of the universe.

3.3.2 Movement of Space and the Nature of Fields

Space is constantly in motion. The motion of space itself can be described using geometric points, known as **space points**, and the trajectories of these points form **space lines**. Fields are the effects of this spatial movement. For example, electromagnetic fields and gravitational fields are caused by the movement of space around objects.

3.3.3 Information Storage in Space

Space has the capacity to store infinite information. The movement of objects imprints information onto the surrounding space. This information is transmitted throughout the universe at the speed of light and can be stored indefinitely in two-dimensional space, as any point in space is mathematically linked to the rest of the universe.

3.3.4 The Origin of Spatial Dimensions

The three-dimensional nature of space is due to its cylindrical helical motion. Space moves equally in all three perpendicular directions, resulting in three dimensions. The **right-hand helical rule** governs space's motion: if the thumb points in the direction of linear motion, the fingers indicate the direction of circular motion around that line.

3.4 Time

3.4.1 Physical Definition of Time

Time is the observer's sensation of the movement of space around them. Time is not an independent entity but arises from the perception of spatial movement. Space's continuous cylindrical helical motion creates the feeling of time passing.

3.4.2 The Relationship Between Time and the Observer

Time exists because of observers. Without an observer, there would be no time, as time is a description of the observer's experience of space moving around them. Different observers can experience time differently based on their relative movement, as described by relativity.

3.4.3 The Relativity of Time

Time is a function of spatial movement, and all physical quantities like velocity, momentum, and energy are ultimately derived from time and spatial displacement. The question of the origin of time or the universe is meaningless because the universe always exists, and time is merely an effect of spatial motion as experienced by observers.

3.5 Fields

3.5.1 Mathematical Definition of Fields

In mathematics, a field is defined as follows: if every point in space (or a part of space) corresponds to a specific quantity, that space is called a field.

If the quantity corresponding to each point is a scalar, the field is called a scalar field. If the quantity corresponding to each point is a vector, the field is called a vector field.

3.5.2 Unified Definition of the Four Physical Fields

The four fundamental physical fields (gravitational field, electric field, magnetic field, and nuclear force field) are closely related to the motion of space. In the Unified Field Theory, these four fields together are considered as the cylindrical helical motion of space.

The essence of a field is the motion of space, and the effects of a field are derived from the motion of space itself.

3.5.3 Basic Properties of Fields

A field represents the motion of the space surrounding a particle relative to the observer. The field exerts influence on objects (such as applying force) by changing the spatial position of the object.

Fields are fundamentally vector fields, representing the effects of spatial motion. The particle, space, observer, and motion are all essential for the concept of a field to hold meaning.

3.5.4 Forms of Fields

Fields can be described in three forms:

- **Three-dimensional distribution:** Describes the displacement of space in a three-dimensional volume.
- **Two-dimensional surface distribution:** The relationship between the field in three-dimensional space and on two-dimensional surfaces can be described by the divergence.
- **One-dimensional curve distribution:** The relationship between the field on two-dimensional surfaces and one-dimensional curves can be described by the curl.

3.5.5 Application of Mathematical Tools

- Gauss's theorem in field theory is used to describe the relationship between the distribution of fields in three-dimensional space and on two-dimensional surfaces.
- Stokes' theorem in field theory is used to describe the relationship between the distribution of fields on two-dimensional surfaces and one-dimensional curves.
- The gradient theorem is used to describe the distribution of physical quantities in scalar fields along a curve.

3.5.6 Core Essence of Fields

Fields are the cylindrical helical motion of space, where the curl describes the rotational motion and the divergence describes the linear motion.

4 Spacetime Unification Equation

4.1 Time, Space, and the Speed of Light in Unified Field Theory

In unified field theory, time, space, and the speed of light are interconnected. The speed of light is treated as a vector, $\vec{c}$, where the magnitude c remains constant, but the direction can change with time t, the velocity of the source, and the observer:

$$\vec{c} = c\vec{N}$$

Time is proportional to the distance travelled by space at the speed of light around the observer. The experience of time arises from space points moving outward from the observer in a spiral motion at speed $\vec{c}$.

4.2 Spacetime Equation

For a space point p starting from the observer at time zero and moving with vector speed $\vec{c}$, the distance $\vec{r}$ is proportional to time t, giving the spacetime unification equation:

$$\vec{r}(t) = \vec{c}t = x\vec{i} + y\vec{j} + z\vec{k}$$

In scalar form:

$$r^2 = c^2t^2 = x^2 + y^2 + z^2$$

This shows the unification of space and time, where time is expressed as spatial displacement at the speed of light.

4.3 Space Displacement and Physical Concepts

All fundamental physical concepts like mass, charge, and energy are derived from spatial displacement. Physics fundamentally describes motion, which is constituted by space displacement.

5 Three-Dimensional Cylindrical Helical Spacetime Equation

In unified field theory, all objects, including space, move in a cylindrical helical pattern. This motion is one of the universe's fundamental laws. The space surrounding objects also follows this helical motion.

We now define the three-dimensional cylindrical helical spacetime equation to replace the four-dimensional spacetime equation in relativity.

Let point o be stationary relative to the observer. A three-dimensional Cartesian system (x, y, z) is established with o as the origin. At time $t' = 0$, a space point p has initial coordinates (x_0, y_0, z_0), and its displacement vector is $\vec{r_0}$. After time t, p moves to (x, y, z), with the displacement vector $\vec{r}$.

The displacement vector in cylindrical helical motion is:

$$\vec{r}(t) = \vec{r_0} + \vec{c}t = (x_0 + x)\,\vec{i} + (y_0 + y)\,\vec{j} + (z_0 + z)\,\vec{k}$$

In simplified form:

$$\vec{r}(t) = \vec{c}t = x\vec{i} + y\vec{j} + z\vec{k}$$

Scalar form:

$$r^2 = c^2t^2 = x^2 + y^2 + z^2$$

These equations show that time is the description of space moving at the speed of light. In three-dimensional space, when any dimension moves at light speed, we interpret this as time.

5.1 Helical Motion

If point p rotates in the x, y-plane with angular velocity ω, and moves along the z-axis with velocity h, with R as the radius of the rotation, we have:

$$x = x_0 + R\cos\omega t$$
$$y = y_0 + R\sin\omega t$$
$$z = z_0 + ht$$

In vector form:

$$\vec{r} = \vec{r_0} + \vec{c}t = (x_0 + R\cos\omega t)\,\vec{i} + (y_0 + R\sin\omega t)\,\vec{j} + (z_0 + ht)\,\vec{k}$$

Simplified form:

$$\vec{r} = R\cos\omega t\vec{i} + R\sin\omega t\vec{j} + ht\vec{k}$$

This is the three-dimensional cylindrical helical spacetime equation. It describes the motion of everything in the universe, from galaxies to subatomic particles.

5.2 Rotational and Linear Motion Relationship

The cross-product of rotational displacement vectors X and Y in the x, y-axes and linear displacement Z in the z-axis is:

$$X \times Y = Z \quad \text{and} \quad Y \times X = -Z$$

This shows the connection between rotational and linear motion, derived from the "parallel" and "vertical" principles. The equation $X \times Y = Z$ can be interpreted as a vector area proportional to Z, demonstrating the relationship between rotational and linear motion.

5.3 Key Points

- There are many space points around o, each following a helical path.
- Helical lines originate from and terminate at particles; they don't appear in empty space.
- The cylindrical helical motion is a combination of linear and rotational movement.
- The helical line describes the motion of the spatial vector $\vec{r}$, not just the point p.

6 The Nature of the Speed of Light

6.1 The Essence of Light Speed

The speed of light plays a crucial role in physics, far beyond just being related to light emission. It reflects the fundamental laws of nature. In unified field theory, light speed is extended to a vector, which highlights the deep connection between time and space. Unified field theory asserts that space is fundamental, and time is a description of space moving at the speed of light as perceived by the observer. Time, space, and the speed of light are interlinked, and light speed serves as the bridge connecting time and space.

6.2 Light Speed and Relativistic Effects

The speed of light is the highest possible speed in the universe, as exceeding it would lead to meaningless physical quantities. Relativity explains the relativistic effects such as length contraction and time dilation that occur when objects approach the speed of light. At the speed of light, the length of an object contracts to zero, and time stops flowing. Unified field theory posits that these effects are both real and observer-dependent.

6.3 Explanation of the Vertical State

In unified field theory, the **vertical state principle** states that the motion in the physical world is equivalent to a vertical state in the geometric world. When an object moves in a particular direction, the space in that direction tilts. As the object's speed increases, the tilt angle increases. When the object reaches the speed of light, the geometric space rotates 90 degrees, causing the length along the direction of motion to reduce to zero.

This means that the motion state of an object is directly connected to the vertical state of space. When an object moves at light speed, the spatial projection along its direction of motion becomes zero.

6.4 Explanation of Light Speed Invariance

The invariance of the speed of light in relativity can be explained through the unified field theory's definition of time. Time is proportional to the distance travelled by space at the speed of light, as given by:

$$r = ct$$

Thus, the speed of light c is defined as:

$$c = \frac{r}{t}$$

Since space displacement r and time t are essentially the same thing, the speed of light remains constant. Any change in the spatial displacement r will result in a corresponding change in time t, keeping the value of c unchanged. This explains why the speed of light is always constant, regardless of the motion of the light source relative to the observer.

7 Explaining the Constancy of the Speed of Light in Lorentz Transformation

7.1 Explaining the Constancy of the Speed of Light

Consider two inertial reference frames, s and s', where the point p is at rest in the s' frame. Let frame s move relative to frame s' at a constant velocity v along the x-axis. At time $t = t' = 0$, the origins of s and s' coincide. We examine the event happening at point p, and we want to find the relationship between the space-time coordinates of the event in both reference frames.

In the s' frame, the event occurs at time t' and at position x' on the x'-axis. In the s frame, the event occurs at time t and at position x on the x-axis. According to Galilean relativity, the relationship between the two frames is:

$$x' = x - vt$$
$$x = x' + vt'$$

However, special relativity states that time and space measurements depend on the relative velocity v between the observers. To correct for this relativistic effect, we introduce a Lorentz factor k, giving:

$$x' = k(x - vt)$$
$$x = k(x' + vt')$$

7.2 Condition for the Constancy of the Speed of Light

To determine the value of k, consider a light pulse emitted from the origin at $t = t' = 0$ that propagates along the x-axis. According to the principle of the constancy of the speed of light, the speed of light c is the same in both reference frames. Therefore, we have:

$$x = ct$$

$$x' = ct'$$

Substituting these into the previous equations:

$$ct' = k(ct - vt)$$
$$ct = k(ct' + vt')$$

Multiplying the two equations:

$$c^2tt' = k^2(ct - vt)(ct' + vt')$$

Expanding the right-hand side:

$$c^2tt' = k^2(c^2tt' - v^2tt')$$

Canceling c^2tt', we get:

$$c^2 = k^2(c^2 - v^2)$$

Thus, the Lorentz factor k is:

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

7.3 Lorentz Transformation Equations

With the Lorentz factor k, we can now derive the full Lorentz transformation equations:

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}$$
$$x = \frac{x' + vt'}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The time transformation equations are:

$$t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$
$$t = \frac{t' + \frac{vx'}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

These are the classical Lorentz transformation equations, which show how space and time coordinates relate between different inertial frames.

7.4 Cause of the Relativistic Factor

The relativistic factor $\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ arises from the assumption that the speed of light is the same in all inertial reference frames. As an object's velocity v approaches the speed of light c, time dilation and length contraction occur, leading to the need for this factor:

- When $v = 0$, the relativistic factor equals 1, reducing Lorentz transformation to Galilean transformation. - As $v \to c$, the relativistic factor approaches infinity, reflecting that light speed is the ultimate speed limit in the universe.

7.5 Explanation of the Constancy of Light Speed in the Perpendicular Direction

We now consider the case where the motion of the spatial point is perpendicular to the velocity v. Assume point p moves along the y-axis in the s frame while being stationary in the s' frame.

At $t = t' = 0$, the origins of s and s' coincide. The point p leaves the origin and moves at speed c along the y'-axis for a time t', reaching position p. In both frames, the speed of light is measured to be the same:

$$\frac{OP}{t} = \frac{O'P}{t'} = c$$

Thus, even in the perpendicular direction, the speed of light remains invariant in both inertial frames.

7.6 Discussion on Vectorial Light Speed

The unified field theory extends the concept of light speed, suggesting that light speed can be viewed as a vector $\vec{c}$, with magnitude c constant but direction dependent on the motion of the source $\vec{v}$. The relation between $\vec{c}$ and $\vec{v}$ is given by:

$$\cos\theta = \frac{v}{c}$$

This implies that while the magnitude of the speed of light remains constant, its direction can vary with the velocity of the light source.

Using the Lorentz transformation for velocity, we find the components of $\vec{c}$ in s and s' frames:

$$c'_x = \frac{c_x - v}{1 - \frac{c_x v}{c^2}}$$

$$c'_y = \frac{c_y\sqrt{1 - \frac{v^2}{c^2}}}{1 - \frac{c_x v}{c^2}}$$

$$c'_z = \frac{c_z\sqrt{1 - \frac{v^2}{c^2}}}{1 - \frac{c_x v}{c^2}}$$

7.7 Derivation of Space-Time Invariance

Consider the invariance of space-time intervals. In the s frame, the spatial displacement of point p is:

$$r^2 = c^2t^2 = x^2 + y^2 + z^2$$

Similarly, in the s' frame:

$$r'^2 = c^2t'^2 = x'^2 + y'^2 + z'^2$$

Subtracting the spatial terms from both equations:

$$c^2t^2 - (x^2 + y^2 + z^2) = 0$$
$$c^2t'^2 - (x'^2 + y'^2 + z'^2) = 0$$

Thus, the space-time interval remains invariant in both reference frames. This invariance stems from the constancy of the speed of light, linking space and time through the Lorentz transformation.

7.8 Resolution of the Twin Paradox

According to special relativity, moving clocks tick more slowly. Suppose twin A travels at high speed through space while twin B remains on Earth. Upon A's return, B will have aged more than A.

Unified field theory emphasizes that for any motion, we must specify the observer, the start and end points, and the time duration. In the twin paradox, both A and B start and end their journey on Earth. Since A moves relative to Earth, A's clock runs slower, making A younger than B, who remains at rest relative to Earth.

If both twins were born in space, and A accelerated away from B, A would still be younger when they reunite, due to A's motion relative to B.

8 Unified Field Theory Momentum Formula

8.1 Rest Momentum Formula

The basic assumption of the Unified Field Theory is: Any object o point in the universe, when at rest relative to our observer, will have its surrounding space always expanding outward in a cylindrical helical motion at the speed of light.

Assume there is a point mass o stationary relative to our observer. Any space point p in the surrounding space, at time zero, moves from point o at the speed of light $\vec{c}'$ along a certain direction. After time t', at time t'', it reaches the location where point p is now.

The total displacement of space points around o is n, and one of the displacement vectors is given by $\vec{r}' = \vec{c}'t'$.

We select a suitable solid angle Ω around point o, which just contains one displacement vector $\vec{r'} = \vec{c'}t'$.

The angular momentum describing the motion in the local space around o is:

$$\vec{L} = k\frac{\vec{r'}}{\Omega}$$

Where k is a proportionality constant, and Ω is the arbitrary size of the solid angle.

To describe how the motion of space around point o changes with time, we take the partial derivative of $\vec{L} = k\frac{\vec{r'}}{\Omega}$ with respect to time t':

$$\frac{\partial \vec{L}}{\partial t'} = k\frac{\partial \vec{r'}}{\partial t'}\frac{1}{\Omega} = \frac{k \cdot c'}{\Omega}$$

Since $\vec{r'} = \vec{c'}t'$, substituting into the equation, we get:

$$\frac{\partial \vec{L}}{\partial t'} = \frac{k \cdot c'}{\Omega}$$

Using the mass definition equation $m = \frac{k}{\Omega}$, we can rewrite the equation as the rest momentum formula of Unified Field Theory:

$$\vec{p_{\text{rest}}} = m' \cdot \vec{c'}$$

Here, we use m' to represent the rest mass, distinguishing it from the moving mass m, and $\vec{c'}$ to distinguish from the moving velocity $\vec{c}$.

Rest Momentum Explanation: The rest momentum of point o reflects the motion of the surrounding space when the point is at rest. Note that rest momentum does not depend on the distance between o and point p. Therefore, measuring the rest momentum of an object does not require considering the distance between o and point p.

8.2 Moving Momentum Formula

Now, assume the s' frame moves with constant velocity $\vec{v}$ along the positive x-axis relative to the s frame.

The point o, stationary relative to the observer in s', has rest momentum $m'\vec{c'}$.

As point o moves at velocity v relative to the observer in s, both the mass and velocity components of the rest momentum change.

In the s' frame, the rest mass of point o is m', but in the s frame, it becomes the moving mass m. Similarly, the velocity of space point p in the s' frame is $\vec{c'}$, while in the s frame, the velocity becomes $\vec{c}$.

The vectors $\vec{c'}$ and $\vec{c}$ have different directions but the same magnitude c, that is:

$$\vec{c'} \cdot \vec{c'} = \vec{c} \cdot \vec{c} = c^2$$

This is proven in detail in the section on the constancy of the speed of light in the Lorentz transformation.

In the s frame, the moving momentum cannot be simply written as $m \cdot \vec{c}$, because $\vec{c}$ is the velocity of point p relative to the observer in s, not the velocity of point o relative to the observer.

Thus, we need to consider the velocity of point p relative to o, denoted by $\vec{u}$, which relates to the observed velocity $\vec{v}$ and the velocity of light $\vec{c}$ as follows:

$$\vec{c} = \vec{u} + \vec{v}$$

Hence, the velocity of point p relative to point o is:

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

Therefore, the moving momentum is given by:

$$\vec{p_{\text{mov}}} = m \cdot \vec{u} = m(\vec{c} - \vec{v})$$

In classical mechanics and relativity, where the light speed is ignored (i.e., $\vec{c} = 0$), the momentum formula reduces to:

$$\vec{p_{\text{mov}}} = m \cdot \vec{v}$$

Thus, the momentum in classical mechanics and relativity can be considered a special case of the Unified Field Theory momentum formula when $m \cdot \vec{c}$ is neglected.

8.3 The Quantity of Moving Momentum and Rest Momentum is Equal

To show that the moving momentum and rest momentum have the same magnitude, we take the dot product of the moving momentum formula $\vec{p_{\text{mov}}} = m(\vec{c} - \vec{v})$ with itself:

$$p^2 = m^2(c^2 - 2\vec{c} \cdot \vec{v} + v^2)$$

Thus:

$$p = m\sqrt{c^2 - 2\vec{c} \cdot \vec{v} + v^2}$$

The magnitude of the rest momentum $m'c$ and the magnitude of the moving momentum $m\sqrt{c^2 - 2\vec{c} \cdot \vec{v} + v^2}$ should be equal, so:

$$m'c = m\sqrt{c^2 - 2\vec{c} \cdot \vec{v} + v^2}$$

8.4 Analysis Using Components of $(\vec{c} - \vec{v})$

Let us now analyze the components of $(\vec{c} - \vec{v})$.

The three components of $(\vec{c} - \vec{v})$ are $(c_x - v_x), (c_y - v_y), (c_z - v_z)$. We denote the magnitude as u, so:

$$u = \sqrt{(c_x - v_x)^2 + (c_y - v_y)^2 + (c_z - v_z)^2}$$

Expanding this expression gives:

$$u = \sqrt{c_x^2 + c_y^2 + c_z^2 + v_x^2 + v_y^2 + v_z^2 - 2(\vec{c} \cdot \vec{v})}$$

Since $c_x^2 + c_y^2 + c_z^2 = c^2$ and $v_x^2 + v_y^2 + v_z^2 = v^2$, the final expression is:

$$u = \sqrt{c^2 + v^2 - 2\vec{c} \cdot \vec{v}}$$

This shows that the magnitude of momentum is preserved regardless of the reference frame, depending on the relative angle between $\vec{c}$ and $\vec{v}$.

8.5 Deriving the Mass-Velocity Relation

As the velocity v of the object approaches the speed of light c, $\cos\theta$ approaches 1, so:

$$m'c = m\sqrt{c^2 - v^2}$$

From this, we derive the relativistic mass-velocity relation:

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

This shows that the mass of an object increases with its velocity, in accordance with the law of conservation of momentum.

9 Unified Field Theory Dynamics Equations

9.1 General Definition of Force

Force is the measure of how the motion of an object (or particle) in space relative to an observer, or the motion of the space surrounding the object itself, changes over a given spatial region or over time.

From a mathematical perspective, force is defined as the derivative of momentum with respect to position or time.

Force is divided into two categories:

- **Inertial force**: It is the derivative of momentum with respect to spatial position, specifically with respect to a solid angle. Inertial force is independent of the distance between the object being acted upon and the object applying the force, or the observer.
- **Interaction force**: It is the derivative of momentum with respect to spatial position, but the position here can be in terms of volume, surface, or displacement vector. Hence, interaction forces depend on the distance between the objects.

In Newtonian mechanics, inertial force and gravitational force are examples of these two types of forces:

- Inertial forces are independent of the distance between the acting and receiving objects.
- Gravitational force, which belongs to interaction forces, is distance-dependent.

In electromagnetism:

- Lorentz force is an inertial force.
- Ampère's force is an interaction force.

This section will generalize Newtonian inertial force to include electromagnetic and nuclear forces.

9.2 Writing the Four Inertial Forces of the Universe in a Single Equation

To describe the momentum of a particle o around a spatial point p, we use the expression for momentum:

$$\vec{p_{\text{motion}}} = m(\vec{c} - \vec{v})$$

where o's momentum is independent of the distance between point o and point p, which makes it similar to inertial force.

Following Newtonian mechanics' idea—that inertial force is the derivative of momentum with respect to time—we can generalize this concept and claim that the universal four types of inertial forces can be described as the change in momentum $\vec{p_{\text{motion}}} = m(\vec{c} - \vec{v})$ over time t. Thus, we have the unified field dynamics equation:

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

The terms in this equation can be interpreted as follows:

- $(\vec{c} - \vec{v})\frac{dm}{dt}$: mass-increase force.
- $m\frac{d\vec{c}}{dt} - m\frac{d\vec{v}}{dt}$: acceleration force.

In the context of unified field theory, the different types of forces have the following interpretations:

- $\vec{c}\frac{dm}{dt}$ is the electric field force.
- $\vec{v}\frac{dm}{dt}$ is the magnetic field force.
- $m\frac{d\vec{v}}{dt}$ is the inertial force, which also corresponds to Newton's second law and gravitational force.
- $m\frac{d\vec{c}}{dt}$ is the nuclear force.

9.3 Detailed Derivation of Nuclear Force

In unified field theory, the nuclear force is represented by $m\frac{d\vec{c}}{dt}$. This is derived from the relativistic energy equation $E = mc^2$. By analyzing the energy transformation, we can derive the detailed expression for the nuclear force.

First, the work done by a force is expressed as the integral of the force over a displacement:

$$E = \int_0^r \vec{F} \cdot d\vec{r} = \vec{F} \cdot \vec{r}$$

where r is the displacement vector, and the integration limits are from 0 to r.

Using the relationship for energy and momentum:

$$E = \vec{F} \cdot \vec{r} = m\vec{c} \cdot \frac{d\vec{r}}{dt}$$

where $\frac{d\vec{r}}{dt} = \vec{c}$ based on the unified field theory space-time unification equation $\vec{r} = \vec{c}t$.

Thus, we get:

$$E = \vec{F} \cdot \vec{r} = m\vec{c} \cdot \vec{c} = mc^2$$

This derivation shows that nuclear force is fundamentally connected to the energy-mass equivalence formula $E = mc^2$. It demonstrates how nuclear force is responsible for the energy associated with the motion of particles through space.

9.4 Mass-Increase Force and Mass-Increase Motion

The term $(\vec{c} - \vec{v})\frac{dm}{dt}$ represents the mass-increase force, which causes motion in a discontinuous manner. For example, when a photon reaches the energy threshold to achieve light speed, its mass suddenly changes, allowing it to accelerate from rest to the speed of light instantaneously. This discontinuous motion appears instantaneous to an observer.

In quantum mechanics, the discontinuity in electromagnetic wave energy emission can also be explained by mass-increase motion. When the photon reaches the required energy level, it moves at the speed of light, and any additional energy cannot increase its speed further.

9.5 Special Case: When Space is Static

If we assume that space is static, i.e., $\vec{c} = 0$, the unified field dynamics equation reduces to the classical Newtonian or relativistic mechanics equation:

$$\vec{F} = \frac{d\vec{p}}{dt} = -\vec{v}\frac{dm}{dt} - m\frac{d\vec{v}}{dt}$$

This implies that the Newtonian and relativistic force equations are special cases of the broader unified field theory.

9.6 Relationship Between Inertial and Interaction Forces

While inertial and interaction forces share similarities, they differ in their dependence on distance:

- **Inertial force**: Independent of distance, as it is analyzed using solid angles, which do not vary with distance.
- **Interaction force**: Dependent on distance, as it is analyzed using three-dimensional cones or Gaussian surfaces, both of which vary with distance.

9.7 Analysis of Nuclear Force in Component Form

To further analyze the momentum equation $m' \; c = m \; \sqrt{c^2 - 2\,\vec{c} \cdot \vec{v} + v^2}$, we break it down into components:

The components of $(\vec{c} - \vec{v})$ are $(c_x - v_x)$, $(c_y - v_y)$, and $(c_z - v_z)$. Thus, we can express u as:

$$u = \sqrt{(c_x - v_x)^2 + (c_y - v_y)^2 + (c_z - v_z)^2}$$

which expands to:

$$u = \sqrt{c_x^2 + c_y^2 + c_z^2 + v_x^2 + v_y^2 + v_z^2 - 2\vec{c} \cdot \vec{v}}$$

and simplifies to:

$$u = \sqrt{c^2 + v^2 - 2\vec{c} \cdot \vec{v}}$$

This analysis is consistent with the momentum equation, illustrating that nuclear force and momentum conservation are valid across different reference frames.

10 Unified Field Theory Energy Equation

10.1 Definition of Energy

- Basic Concept of Energy: Energy is the motion of a particle or the space around a particle relative to an observer within a certain region of space (or over a certain time interval, due to space-time equivalence). - Relation to Momentum: The definition of energy is similar to that of momentum, with the key difference being that momentum is a vector while energy is a scalar, each describing the extent of motion from a different perspective. - Necessary Conditions: The definition of energy requires four conditions: space, material point, observer, and motion. Without these four elements, energy becomes meaningless. - Space and Observer: Purely empty space without any material points or an undefined observer makes the concept of energy non-existent.

10.2 Unified Field Theory Energy Equation

- Derivation: Starting from the scalar form of the Unified Field Theory momentum equation $m'c = mc\sqrt{1 - v^2/c^2}$ and multiplying both sides by the scalar speed of light c, we derive the Unified Field Theory energy equation:

$$e = m'c^2 = mc^2\sqrt{1 - v^2/c^2}$$

- Rest Energy: $m'c^2$ is the rest energy of point o. When the particle's velocity $v = 0$, this equation becomes equivalent to the relativistic mass-energy equation $e = mc^2$. - Energy in Motion: The energy of a particle moving with velocity v is $mc^2\sqrt{1 - v^2/c^2}$, which is equal to the rest energy $m'c^2$. - Difference from Relativity: In relativity, the energy when point o is at rest ($m'c^2$) and when it is moving (mc^2) are considered different. Unified Field Theory posits that these energies are the same, with variations in how different observers perceive the form of the motion.

10.3 Relation to Classical Mechanics Kinetic Energy Formula

- Kinetic Energy Formula: Unified Field Theory and relativity share the same kinetic energy equation:

$$(m - m')c^2 = E_k$$

where $E_k = \frac{1}{2}mv^2$ is the kinetic energy as defined in Newtonian mechanics. - Series Expansion: Expanding the Unified Field Theory energy equation $e = mc^2\sqrt{1 - v^2/c^2}$ in a series:

$$e \approx mc^2 - \frac{mv^2}{2}$$

Here, $\frac{mv^2}{2}$ represents the kinetic energy E_k from Newtonian mechanics. - Interpretation: The classical kinetic energy E_k is the amount of change in rest mass when the object moves at velocity v.

10.4 Relationship Between Momentum and Kinetic Energy in Unified Field Theory

- Momentum Equation: The rest momentum in Unified Field Theory is $P' = m'C$ and the momentum in motion is $P = m(C - V)$. The scalar form is:

$$p = mc\sqrt{1 - v^2/c^2} = m'c$$

- Photon Momentum and Energy: For photons, the relationship between momentum and energy is given by:

$$p = \frac{e}{c}$$

This means that the photon's momentum p is equal to its energy e divided by the speed of light c. - Properties of Photons: Photons have zero rest mass and zero rest energy, but their energy in motion can be expressed as mc^2. - Relationship Between Energy and Relativistic Momentum: Squaring both sides of the Unified Field Theory energy equation:

$$e^2 = m'^2c^4 = m^2c^4 - m^2c^2v^2$$

This leads to:

$$m^2c^4 = p'^2c^2 + m'^2c^4$$

- Differences with Relativity: Although the form is similar to relativity, Unified Field Theory asserts that the total energy squared is $e^2 = m'^2c^4$, while relativity includes the kinetic energy term in the total energy squared.

11 Gravitational Field and Mass

In the Unified Field Theory, the mass m of a body at point o represents the number of space displacement vectors $\vec{r}$ that radiate from o in a cylindrical spiral motion at the speed of light within a solid angle of 4π. The gravitational field $\vec{A}$ produced by point o indicates the number of such space displacement vectors passing through a Gaussian surface S that encloses o.

11.1 The Nature of Gravitational Force

The most perplexing question about gravity is how two arbitrary objects in the universe generate and transmit gravitational force to each other. In essence, the nature of gravitational force is quite simple.

11.2 Force is a Property, Not an Entity

Traditionally, we view force as some tangible entity, but in the context of unified field theory, force is actually a property of relative motion between objects. When two objects are in relative motion, especially accelerating motion, we describe this interaction as a "force." Thus, force is not a concrete thing; it is simply a way of describing the property of objects' relative motion.

11.3 The Source of Gravitational Force: Changes in Space

Imagine that a mass o, relative to an observer, is stationary. Meanwhile, another mass p is situated at a distance r from it. The space between these two masses is in motion. This motion of space is what manifests as the gravitational attraction between them. Hence, gravitational force arises from the movement of space between two masses. The relative motion of space and the relative motion of the two masses are fundamentally the same thing.

11.4 Definition of the Gravitational Field

Consider a point mass o that is stationary with respect to the observer. At time $t = 0$, any point p in space starts from o with a vector light speed $\vec{c}$ and moves in a cylindrical spiral motion, reaching a point at time t'. The space displacement vector is given by:

$$\vec{r}(t) = \vec{c} \cdot t = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$$

Here, $\vec{r}$ is a function of space coordinates (x, y, z) and time t, written as:

$$\vec{r} = \vec{r}(x, y, z, t)$$

We construct a Gaussian surface $S = 4\pi r^2$ surrounding point o, uniformly divided into many small patches. Let $\Delta\vec{S}$ represent a small vector surface element where Δn number of displacement vectors pass through. The gravitational field at point p, denoted as A, can be defined as:

$$A = \text{constant} \cdot \frac{\Delta n}{\Delta S}$$

This is a simplified scalar expression, and we need to include the vector properties of the field. Considering that $\vec{r} = \vec{c} \cdot t$ crosses the surface element $\Delta\vec{S}$, the vector form of the gravitational field is given by:

$$\vec{A} = -\frac{G \cdot k \cdot \Delta n \cdot \vec{r}}{\Delta S \cdot r}$$

Here, G is the gravitational constant, and k is a proportionality constant. The direction of $\vec{A}$ is opposite to the displacement vector $\vec{r}$.

For cases where $\vec{r}$ is not perpendicular to the surface element $\Delta\vec{S}$, we introduce an angle θ between $\vec{r}$ and the normal vector $\vec{N}$ of the surface element. The gravitational field can then be expressed using the dot product:

$$\vec{A} \cdot \Delta\vec{S} = -A \cdot \Delta S \cdot \cos\theta = -G \cdot k \cdot \Delta n$$

The gravitational field magnitude depends on the density of space displacement vectors passing through the surface. We substitute $\Delta S = \Omega \cdot r^2$ (where Ω is the solid angle) into the field equation:

$$\vec{A} = -\frac{G \cdot k \cdot \Delta n \cdot \vec{r}}{\Omega \cdot r^3}$$

This is the final expression for the gravitational field in the Unified Field Theory.

11.5 Gravitational Field as a Property of Space

A gravitational field is essentially space itself in a state of accelerated motion. The space around a massive object like Earth is continually collapsing toward its center. This constant motion of space manifests as the gravitational field. Even without a test mass, the space surrounding Earth is in a perpetual state of inward acceleration, which we interpret as gravity.

The space around Earth moves uniformly if there is only one mass, so no gravitational force is observed. When a second mass is introduced, the uniformity of space's motion is disturbed. This disturbance manifests as gravitational force, which can be described by the gravitational field equation.

11.6 Equivalence of Inertial and Gravitational Mass

According to Newtonian mechanics, gravitational mass describes an object's ability to accelerate another object, while inertial mass describes the resistance of an object to being accelerated. In unified field theory, these two concepts are inherently linked because both gravitational and inertial effects arise from the same space motion around objects.

If we consider a test mass p subjected to the gravitational field of another mass o, we get:

$$\vec{F} = m\vec{A}$$

where m is the mass of object p, $\vec{A}$ is the gravitational field generated by o at point p, and $\vec{F}$ is the force acting on p. The acceleration $\vec{A}$ can be written as:

$$\vec{A} = -\frac{Gm'\vec{r}}{r^3}$$

where G is the gravitational constant, m' is the mass of object o, and $\vec{r}$ is the position vector from o to p. The total force acting on p is then:

$$\vec{F} = -\frac{Gmm'\vec{r}}{r^3}$$

This is the familiar form of Newton's law of gravitation. In unified field theory, this equation reflects how the motion of space between two masses manifests as gravitational attraction.

11.7 Gravitational Waves and Field Dynamics

A gravitational field is a gradient field, meaning the force depends on the displacement between masses and has a directional component opposite to that displacement. This also reveals the wave-like nature of gravitational fields: the change in gravitational influence propagates through space as a wave, traveling at the speed of light. These waves are helical in nature, in line with the cylindrical, helical motion of space described in unified field theory.

If the magnitude of the position vector $\vec{r}$ remains constant, and only its direction changes (e.g., as one object orbits another), then the gravitational field satisfies:

$$\oint \vec{A} \cdot d\vec{r} = 0$$

This confirms that the gravitational field is a conservative field, meaning the work done by gravity around a closed path is zero.

11.8 Definition of Mass

In the Unified Field Theory, mass m is defined as the number of space displacement vectors in a solid angle Ω. Comparing the gravitational field equation with the classical Newtonian gravitational field equation:

$$\vec{A} = -\frac{G \cdot m \cdot \vec{r}}{r^3}$$

we obtain the mass definition equation:

$$m = \frac{k \cdot \Delta n}{\Omega}$$

In differential form:

$$m = \frac{k \cdot dn}{d\Omega}$$

Integrating both sides over the solid angle 4π, we get:

$$m = k \cdot \frac{\oint dn}{\oint d\Omega} = k \cdot \frac{n}{4\pi}$$

This shows that the mass m represents the number of space displacement vectors distributed over the solid angle 4π.

11.9 Mass-Velocity Relationship

In special relativity, the mass of a body increases with velocity. We now derive this relationship from the mass definition equation. Let the mass of a point o at rest in the s' frame be m', and the mass of the same point in the s frame (moving at velocity v along the x-axis) be m. The mass definitions in both frames are:

$$m' = k \cdot \frac{\oint dn}{\oint d\Omega'}$$

$$m = k \cdot \frac{\oint dn}{\oint d\Omega}$$

The number of displacement vectors n remains the same in both frames, so we only need to find the relationship between $d\Omega'$ and $d\Omega$. Using the Lorentz transformation for space coordinates:

$$x' = \frac{x - v \cdot t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

the differential form is:

$$dx' = \frac{dx}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Thus, the volume elements in both frames are related by:

$$dv' = \frac{dv}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Substituting into the mass equation, we obtain the relativistic mass-velocity relation:

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

This is the relativistic mass-velocity relationship.

11.10 Lorentz Transformation of the Gravitational Field

Now we derive the Lorentz transformation for the gravitational field between two reference frames. Let s' be moving relative to s at velocity v along the x-axis. In the s' frame, the gravitational field is given by:

$$A'_x = -\frac{G \cdot m' \cdot x'}{r'^3}, \quad A'_y = -\frac{G \cdot m' \cdot y'}{r'^3}, \quad A'_z = -\frac{G \cdot m' \cdot z'}{r'^3}$$

Using the Lorentz transformation, the components of the gravitational field in the s frame are:

$$A_x = \frac{A'_x}{\sqrt{1 - \frac{v^2}{c^2}}}, \quad A_y = \frac{A'_y}{1 - \frac{v^2}{c^2}}, \quad A_z = \frac{A'_z}{1 - \frac{v^2}{c^2}}$$

Substituting the components of A'_x, A'_y, A'_z, we get:

$$A_x = -\frac{G \cdot m' \cdot (x - v \cdot t)}{\sqrt{1 - \frac{v^2}{c^2}} \cdot r^3}$$

$$A_y = -\frac{G \cdot m' \cdot y}{(1 - \frac{v^2}{c^2}) \cdot r^3}$$

$$A_z = -\frac{G \cdot m' \cdot z}{(1 - \frac{v^2}{c^2}) \cdot r^3}$$

In vector form, the gravitational field becomes:

$$\vec{A} = -G \cdot m \cdot \gamma \cdot \frac{(x - v \cdot t)\,\vec{i} + y\,\vec{j} + z\,\vec{k}}{\left[\gamma^2 (x - v \cdot t)^2 + y^2 + z^2\right]^{3/2}}$$

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

In polar coordinates, this can be expressed as:

$$\vec{A} = -\frac{G \cdot m}{\gamma^2 \cdot r^2 \cdot (1 - \beta^2 \cdot \sin^2 \theta)^{3/2}} \cdot \vec{e_r}$$

where $\beta = \frac{v}{c}$ and $\vec{e_r}$ is the unit vector along $\vec{r}$. This result shows that Gauss's law applies to both static and moving gravitational fields.

12 Explanation of Newton's Three Laws

Newtonian mechanics includes three fundamental laws and the law of universal gravitation.

The three laws of Newtonian mechanics are stated as:

1. Any object (or point mass) tends to maintain a state of uniform linear motion or rest unless acted upon by an external force. 2. The force exerted on an object causes it to accelerate, and the resulting acceleration is directly proportional to the applied force and inversely proportional to the mass of the object. The acceleration is in the same direction as the force. 3. For every action, there is an equal and opposite reaction.

Newtonian mechanics, according to modern understanding, only holds relative to a particular observer.

Newton defined the momentum of an object as $\vec{p} = m\vec{v}$, where m is the mass and $\vec{v}$ is the velocity.

On careful analysis, the core of Newtonian mechanics is the concept of momentum. The concept of momentum originally comes from Newtonian mechanics, and we can restate Newton's three laws using the concept of momentum.

12.1 Restatement of Newton's Laws Using Momentum

1. With respect to an observer, any point mass with mass m in space tends to maintain a fixed momentum $m\vec{v}$, where $\vec{v}$ is the velocity of the point mass in a certain direction, including a zero velocity (i.e., rest state with zero momentum).

2. When a point mass is subject to an external force, the force causes the momentum to change. The rate of change of momentum $\vec{p}$ with time t is the applied force:

$$\vec{F} = \frac{d\vec{p}}{dt} = \frac{d(m\vec{v})}{dt} = m\vec{a}$$

where $\vec{a}$ is the acceleration of the object.

3. Momentum is conserved. In an isolated system, when point masses interact, the momentum gained by one is equal to the momentum lost by the other, ensuring that the total momentum remains constant.

In Newtonian mechanics, the mass m is considered invariant. However, in special relativity, the mass can change, though the form of the momentum equation remains similar.

12.2 Further Interpretation of Newton's Laws Using the Unified Field Theory

According to the unified field theory, Newton's three laws can be understood further as follows:

1. Relative to an observer, any object's surrounding space always radiates outward with a vector speed of light $\vec{c}$ in a cylindrical helical motion. The number of light-speed space displacements n within a solid angle of 4π is the object's mass:

$$m = k\frac{n}{4\pi}$$

Thus, the object possesses a rest momentum of $m\vec{c}$. When we attempt to move the object, we need to apply an additional momentum (mass m times velocity $\vec{v}$), altering the momentum $m\vec{c}$.

2. Force is the cause of changes in the motion of space around an object, either in terms of the outward radiating motion at the speed of light $\vec{c}$ or the motion at velocity $\vec{v}$. This means that force causes a change in momentum. Therefore, force can be described as the change in the object's motion (or the motion of space around it) over a specific spatial region or time interval. Force is expressed as the rate of change of momentum:

$$\vec{F} = \frac{d\vec{p}}{dt}$$

3. Momentum consists of both the motion of the object in space $m\vec{v}$ and the motion of the space around the object itself $m\vec{c}$. Momentum is a conserved quantity, meaning that different observers may measure different forms of momentum, but the total magnitude remains invariant.

13 Proof of the Equivalence Between Inertial and Gravitational Mass

Newtonian mechanics posits that inertial mass reflects the resistance of an object to acceleration, while gravitational mass determines the strength of the gravitational force it exerts on other objects. According to Newton, in the absence of further explanation, inertial mass and gravitational mass are assumed to be equal. This equivalence is fundamental in Newton's law of gravitation. Using the framework of unified field theory, we can rigorously prove the equivalence between inertial and gravitational mass.

Consider an object of mass m at point o, which is stationary relative to an observer. At a distance r away from o, a second object p with mass m' experiences a gravitational force $\vec{F}$ due to the mass at o, causing an acceleration $\vec{A}$ toward o. According to Newton's law of universal gravitation, the force between two masses is given by:

$$F = -\frac{Gmm'}{r^2}$$

At the same time, by Newton's second law, the force acting on object p due to its gravitational interaction with o leads to an acceleration $\vec{A}$:

$$\vec{F} = -m'\vec{A}$$

Newton assumes, without further justification, that the inertial mass m' in the equation $\vec{F} = -m'\vec{A}$ is equivalent to the gravitational mass m' in the equation $\vec{F} = -\frac{Gmm'}{r^2}\vec{e_r}$. From this assumption, we obtain the following expression for the acceleration $\vec{A}$:

$$\vec{A} = -\frac{Gm}{r^2}\vec{e_r}$$

Here, r is the magnitude of $\vec{r}$, and $\vec{e_r}$ is the unit vector pointing from object p toward o. This result expresses the gravitational field generated by mass m at a distance r, and the equivalence of inertial and gravitational mass is encapsulated in the fact that this acceleration matches the acceleration predicted by Newton's second law for an object of mass m'.

To rigorously prove this equivalence, we now analyze the gravitational field in more detail.

From the unified field theory, the gravitational field at a point is given by:

$$\vec{A} = -\frac{Gkn\vec{r}}{\Omega r^3}$$

For simplicity, let us assume that the number of lines of displacement in the moving space $\vec{r} = \vec{c}t$ is $n = 1$, and let $\vec{r}$ denote the vector from o to p. Thus, the gravitational field can be expressed as:

$$\vec{A} = -\frac{Gk\vec{r}}{\Omega r^3}$$

In this equation, Ω represents the solid angle subtended by the Gaussian surface $s = 4\pi r^2$ surrounding the mass o. When the magnitude of r is fixed, the solid angle Ω is proportional to $\vec{r} \bullet \vec{r} = c^2t^2$, where the vector $\vec{r}$ traces out an area on the Gaussian surface proportional to the solid angle Ω. This area is determined by the perpendicular components of $\vec{r}$ relative to the radial direction.

Thus, we can rewrite the gravitational field equation as:

$$\vec{A} = -\frac{Gk\vec{r}}{c^2t^2r^3}$$

Since G, k, c, and r are constants, we can combine them to yield the simplified form:

$$\vec{A} = -\text{constant} \times \frac{\vec{r}}{t^2}$$

Taking the second time derivative of $\vec{r}$, we obtain the following expression for the acceleration:

$$\vec{A} = -\frac{d^2\vec{r}}{dt^2}$$

This result demonstrates that the acceleration produced by the gravitational field takes the same form as the acceleration in Newton's second law for inertial mass. In other words, the acceleration $\vec{A}$ that object p experiences due to the gravitational field generated by mass m is identical to the acceleration predicted by Newton's law of motion for an object with inertial mass m'.

This equivalence proves that inertial mass is indeed equal to gravitational mass. Whether viewed from the framework of classical mechanics or unified field theory, the equivalence between inertial and gravitational mass is not merely an assumption but a rigorously derived consequence of the underlying physics.

14 The Space-Time Wave Equation and Gravitational Field

Previously, it was pointed out that the space surrounding an object radiates outward in a cylindrical spiral motion. The displacement vector of points in space outside the particle changes with both spatial position and time.

The physical quantity (here, the displacement of points outside the particle, referred to as the displacement vector) changes with both spatial position and time, and can be considered to exhibit a wave process.

We know that there is a significant difference between wave motion and cylindrical spiral motion. A wave is the propagation of vibrations through a medium, while a spiral motion involves the movement of a particle's position in space. However, for space, these two types of motion can coexist.

A single space point moving does not exhibit a wave effect, but a group of space points moving together is different. There is a well-known saying: "No two leaves on a tree are exactly alike." However, for space points, this does not hold. Every point in space is identical to another, and thus, the cylindrical spiral motion of space inherently includes wave-like behavior.

Below, we derive the wave equation of space-time from the earlier space-time unification equation:

$$\vec{r}(t) = \vec{c}\,t = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}$$

and point out its relationship with the gravitational field.

Assume that there is a particle o located in a region of space, which is stationary with respect to the observer. According to the previous definition of time and the space-time unification equation, the time t of the observer and the point o can be represented by the displacement of a space point p around the point o:

$$\vec{r}(t) = \vec{c}\,t = x\,\hat{i} + y\,\hat{j} + z\,\hat{k}$$

We now take the derivative of $\vec{r}$ with respect to time t, yielding:

$$\frac{d\vec{r}}{dt} = \vec{c}$$

Squaring both sides of the above equation gives:

$$\frac{d\vec{r}}{dt} \cdot \frac{d\vec{r}}{dt} = c^2 = \frac{dr}{dt} \cdot \frac{dr}{dt}$$

where c is the magnitude of the vector light speed $\vec{c}$, and r is the magnitude of $\vec{r}$.

We now consider another space point p', which is moving around point o. Let $\vec{L}$ represent its displacement. Since $\vec{L}$ changes with time t and is a function of $\vec{r}$, we differentiate $\vec{L}$ twice with respect to the scalar r, yielding:

$$\frac{\partial^2 \vec{L}}{\partial r^2} = \frac{\partial^2 \vec{L}}{c^2 \partial t^2}$$

In three-dimensional space, this becomes:

$$\frac{\partial^2 \vec{L}}{\partial x^2} + \frac{\partial^2 \vec{L}}{\partial y^2} + \frac{\partial^2 \vec{L}}{\partial z^2} = \frac{\partial^2 \vec{L}}{c^2 \partial t^2}$$

The general solution to this partial differential equation is:

$$L(r,t) = f\left(t - \frac{r}{c}\right) + g\left(t + \frac{r}{c}\right)$$

Here, f and g are two independent functions. The equation $L(r,t) = f\left(t - \frac{r}{c}\right)$ represents a wave propagating outward from point o. The equation $L(r,t) = g\left(t + \frac{r}{c}\right)$, traditionally thought to have no physical meaning, represents a wave converging towards point o from infinity. For ordinary media, this may not make sense, but for space, it has a physical interpretation and could explain phenomena such as the origin of negative charges (to be discussed in more detail later).

This equation also encompasses both the straight-line motion of waves moving outwards from point o and waves converging to point o, which can be considered as a special case where the amplitude of the spiral wave tends to zero.

The special solutions to the equation

$$\frac{\partial^2 \vec{L}}{\partial t^2} = c^2 \frac{\partial^2 \vec{L}}{\partial r^2}$$

are given by:

$$L = A \cos\left[\omega\left(t - \frac{r}{c}\right)\right]$$

and

$$L = A \sin\left[\omega\left(t - \frac{r}{c}\right)\right]$$

The wave propagation speed c is the speed of light, and the wave in space-time is a transverse wave.

In certain cases, the displacement components L_x and L_y in the z-axis plane should describe a circular motion. Thus, we obtain the cylindrical helical space-time wave equation:

$$L_x = A \cos\left[\omega\left(t - \frac{r}{c}\right)\right]$$

$$L_y = A \sin\left[\omega\left(t - \frac{r}{c}\right)\right]$$

In the Unified Field Theory, the gravitational field is considered the source of space oscillations, while the electromagnetic field represents the propagation of these oscillations at the speed of light.

15 Definition of Charge and Electric Field Equation

15.1 Definition of Charge

In the Unified Field Theory, both charge and mass are considered effects of the cylindrical spiral motion of space surrounding a particle, with both originating from the same source—the spiral motion of space at the speed of light.

Consider a point particle o that is stationary with respect to the observer. Let $\vec{r}$ be the displacement vector pointing from o to a surrounding point p in space. A Gaussian surface $S = 4\pi r^2$ surrounds the particle. The cylindrical spiral motion of space causes a rotational displacement on this surface, forming a solid angle Ω.

The mass m of the particle at o is defined as:

$$m = k\frac{1}{\Omega}$$

This equation expresses that the mass corresponds to the number of space displacement vectors $\vec{r}$ that pass through the solid angle 4π. The simplified form represents mass in terms of a unit solid angle containing exactly one space displacement vector $\vec{r}$.

In this framework, charge q represents the rate of change of mass over time. Specifically, charge is defined as the change in mass per unit time and per unit solid angle. The definition of charge is given by:

$$q = k'\frac{dm}{dt} = -k'k\frac{1}{\Omega^2}\frac{d\Omega}{dt}$$

where k' is a constant. This equation indicates that charge depends on the angular velocity of the rotational motion of space. The quantization of charge arises from the fact that $\Omega = 4\pi$ is a discrete value, leading to the quantized nature of charge.

15.2 Relativistic Invariance of Charge

In relativity, charge is invariant under changes in velocity, even though mass increases with speed. From the definition of charge:

$$q = k'\frac{dm}{dt}$$

it follows that when the particle o moves with velocity v, both mass and time t (relative to proper time) increase by the same relativistic factor $\sqrt{1 - \frac{v^2}{c^2}}$, leaving q unchanged. This demonstrates that charge is invariant under relativistic transformations.

15.3 Definition of the Electric Field

Let the stationary point o with charge q produce an electric field E at a point p in space. The electric field at p is determined by a Gaussian surface $S = 4\pi r^2$ surrounding o, where $\vec{r}$ is the displacement vector from o to p. According to Coulomb's law, the electric field is defined as:

$$\vec{E} = \frac{q\vec{r}}{4\pi\varepsilon_0 r^3}$$

where $4\pi\varepsilon_0$ is a constant, and r is the distance between o and p. Substituting the charge definition into this expression, we obtain the geometric form of the electric field:

$$\vec{E} = -\frac{k'k}{4\pi\varepsilon_0}\frac{1}{\Omega^2}\frac{d\Omega}{dt}\frac{\vec{r}}{r^3}$$

This equation expresses the electric field as the density of space displacement vectors $\vec{r}$ passing through the Gaussian surface per unit time. The sign of the electric field depends on whether the field is generated by a positive or negative charge, corresponding to outward or inward space displacement, respectively.

15.4 Explanation of Coulomb's Law

Coulomb's law states that the force $\vec{F}$ between two charges q and q' in vacuum is proportional to the product of the charges and inversely proportional to the square of the distance r between them:

$$\vec{F} = \frac{kqq'}{r^2}\vec{e_r} = \frac{qq'\vec{r}}{4\pi\varepsilon_0 r^3}$$

where k is a proportionality constant, ε_0 is the permittivity of free space, and $\vec{e_r}$ is the unit vector along $\vec{r}$. Using the charge and electric field definitions, we see that the electric field produced by q at p is:

$$\vec{E} = -\frac{k'k}{4\pi\varepsilon_0}\frac{1}{\Omega^2}\frac{d\Omega}{dt}\frac{\vec{r}}{r^3}$$

The field at point p causes a force on charge q', and the resulting interaction is described by Coulomb's law.

15.5 Positive and Negative Charge Models

In the Unified Field Theory, positive and negative charges are modeled as cylindrical spiral motions of space. A positive charge is characterized by outward radial space displacement, with the rotation of space following a right-handed spiral. The radial velocity of the spiral is the speed of light, and the space displacement vectors point outward from the charge.

For a negative charge, the radial space displacement vectors point inward, toward the charge, and the spiral motion also follows a right-handed rule. The radial velocity is again the speed of light, but the direction of displacement is opposite to that of a positive charge.

The cylindrical spiral motion of space surrounding the charge is the root cause of the electric field generated by charged particles. The right-hand rule can be used to describe the direction of rotation in the field lines around positive and negative charges.

15.6 Geometrical Explanation of Charge Attraction and Repulsion

The interaction between charges can be explained geometrically using the cylindrical spiral motion model:

Attraction between opposite charges: When a positive and negative charge are near each other, the rotational parts of the spiral motions in their respective space fields cancel out, leading to a reduction in the space between them. This manifests as an attractive force between the charges.

Repulsion between like charges: For two positive or two negative charges, the rotational components of their respective spiral space fields reinforce each other, increasing the space between them and causing a repulsive force.

In the case of equal and opposite charges, the space fields of the charges cancel out when they come into contact, leading to the mutual cancellation of their effects, including mass and charge. This explains why equal amounts of positive and negative charge can neutralize each other.

16 Electromagnetic Force as the Product of Velocity and the Rate of Change of Mass

The momentum formula in both relativity and Newtonian mechanics is given as:

$$\vec{p} = m\vec{v}$$

However, in the Unified Field Theory, the momentum formula is:

$$\vec{p} = m(\vec{c} - \vec{v})$$

Here, momentum includes not only the velocity of the object but also the contribution from the speed of light $\vec{c}$. In Unified Field Theory, the force is defined as the time derivative of the momentum:

$$\vec{F} = \frac{d\vec{p}}{dt} = \frac{d[m(\vec{c} - \vec{v})]}{dt}$$

Taking the derivative, we obtain:

$$\vec{F} = \vec{c}\frac{dm}{dt} - \vec{v}\frac{dm}{dt} + m\frac{d\vec{c}}{dt} - m\frac{d\vec{v}}{dt}$$

In this equation, $\vec{c}$ is the vector for the speed of light, $\vec{v}$ is the velocity of the object, m is the mass of the object, and t is time. The first two terms, $\vec{c}\frac{dm}{dt} - \vec{v}\frac{dm}{dt}$, represent the force due to the change of mass over time, referred to as "mass-increasing force."

> In Unified Field Theory, this mass-increasing force is interpreted as the electromagnetic force, where: $\vec{c}\frac{dm}{dt}$ represents the electric field force, and $\vec{v}\frac{dm}{dt}$ represents the magnetic field force.

16.1 Derivation of Electrostatic Force and Dynamic Electric Force

Assume that the point mass o is stationary with respect to the observer in the frame s', with a rest mass m', and the surrounding space is moving away from o at the vector speed of light $\vec{c}'$. The electrostatic force acting on the object can be expressed as:

$$\vec{F_{\text{static}}} = \vec{c'}\frac{dm'}{dt'}$$

Now, assume the point mass o is moving with velocity $\vec{v}$ along the x-axis in the frame s. In this case, the dynamic electric force in the x-axis direction is given by:

$$\vec{F_{X_{\text{dynamic}}}} = \vec{c_x}\frac{dm}{dt}$$

Since the speed of light c and the charge $\frac{dm}{dt}$ do not change with velocity, we have:

$$\vec{F_{X_{\text{static}}}} = \vec{F_{X_{\text{dynamic}}}}$$

This shows that the static electric force and the dynamic electric force in the x-axis are equivalent.

16.2 Detailed Derivation of Magnetic Force

Next, we consider the magnetic force, which acts perpendicular to the direction of motion.

In the y-axis, the vector light speed changes. In the frame s', the static electric force in the y-direction is given by:

$$\vec{F_{y_{\text{static}}}} = \vec{c'_y}\frac{dm'}{dt'}$$

This can also be written as:

$$F_{y_{\text{static}}} = c\frac{dm'}{dt'}$$

In the frame s, the dynamic electric force in the y-direction is given by:

$$\vec{F_{y_{\text{dynamic}}}} = \vec{c_y}\frac{dm}{dt}$$

Using the relativistic velocity transformation, we obtain:

$$F_{y_{\text{dynamic}}} = c\sqrt{1 - \frac{v^2}{c^2}}\frac{dm}{dt}$$

Thus, the relation between the static and dynamic forces in the y-direction is:

$$\sqrt{1 - \frac{v^2}{c^2}}F_{y_{\text{static}}} = F_{y_{\text{dynamic}}}$$

Similarly, for the z-axis, we have the same relationship. This derivation matches the relativistic transformation of electromagnetic force.

Unifying Electric and Magnetic Fields

When the point mass o carries a charge q, the electric field in the rest frame is expressed as:

$$\vec{E}' = \frac{\vec{F_{\text{static}}}}{q} = \vec{c}'\frac{dm'}{dt'}\frac{1}{q}$$

The dynamic electric field is given by:

$$\vec{E} = \frac{\vec{F_{\text{dynamic}}}}{q} = \vec{c}\frac{dm}{dt}\frac{1}{q}$$

In the x-axis direction, since the speed of light and the charge are invariant, we have:

$$\vec{E_x} = \vec{E_x'}$$

In the y-axis and z-axis directions, the dynamic electric field changes with velocity, expressed as:

$$F_y = \frac{dm}{dt}c\sqrt{1 - \frac{v^2}{c^2}}$$

16.3 Magnetic Field Derivation

Now, let's delve into the derivation of the magnetic field. The dynamic electric force can be split into two parts:

- One part independent of the velocity $\vec{v}$, - The other part related to the velocity $\vec{v}$.

The perpendicular component of the dynamic electric force is given by:

$$F_\perp = \frac{dm}{dt}c\frac{1 - \frac{v^2}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

We can decompose this into electric force and magnetic force. The electric force is:

$$\frac{dm}{dt}c\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The magnetic force, related to the velocity $\vec{v}$, is expressed as:

$$\frac{dm}{dt}c\frac{\frac{v^2}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Thus, the relationship between the electric field $\vec{E}$ and the magnetic field $\vec{B}$ is described by the following vector cross-product relation:

$$\vec{B} = \frac{1}{c^2}\vec{v} \times \vec{E}$$

This result is consistent with the description of electromagnetism in relativity.

17 Definition of the Magnetic Field Equation

In the Unified Field Theory, the magnetic field and electric field are distinct fields that cannot directly interact or be simply added together. It has been observed that when a charged particle moves at a constant velocity relative to an observer, the electric field changes. The part of the electric field that changes can be considered as the magnetic field, meaning that the magnetic field is generated by the changing electric field due to the velocity of the particle. The Unified Field Theory adopts this view.

Let us assume that in the inertial reference frame s', a particle o at rest with respect to the observer, with mass m' (when moving at speed $\vec{v}$, the mass is m), carries a positive charge q, and generates a static electric field $\vec{E'}$ at a point p in the surrounding space (where p can be treated as a point in space or a field point of observation). The position vector from o to p is $\vec{r'}$ (when moving at speed $\vec{v}$, it becomes $\vec{r}$).

We take the length of $\vec{r'}$ as r' (when moving at speed $\vec{v}$, it becomes r) and construct a Gaussian surface $s' = 4\pi r'^2$ enclosing the point o.

In the inertial reference frame s, when the point o moves with constant velocity $\vec{v}$ along the x-axis, the changing electric field in the direction perpendicular to $\vec{v}$ can be considered as the magnetic field $\vec{B}$.

> A simple idea is that the magnetic field $\vec{B}$ can be obtained by multiplying the moving electric field $\vec{E}$ by the velocity $\vec{v}$. Since the magnetic field is maximum when the velocity $\vec{v}$ and electric field $\vec{E}$ are perpendicular, the relation between them should be a vector cross product, leading to the following relationship:

$$\vec{B} = \text{constant} \cdot (\vec{v} \times \vec{E})$$

To find the exact form of the moving electric field $\vec{E}$, we start from the definition of the static electric field obtained from Coulomb's law:

$$\vec{E'} = \frac{q\vec{r'}}{4\pi\varepsilon_0 r'^3}$$

Applying Lorentz transformation (since the charge o is moving relative to the observer), the moving electric field becomes:

$$\vec{E} = \frac{q\gamma}{4\pi\varepsilon_0} \frac{(x - vt)\vec{i} + y\vec{j} + z\vec{k}}{\left[\gamma^2(x - vt)^2 + y^2 + z^2\right]^{\frac{3}{2}}}$$

Thus,

$$\vec{v} \times \vec{E} = \frac{q\gamma}{4\pi\varepsilon_0} \frac{\vec{v} \times \left[(x - vt)\vec{i} + y\vec{j} + z\vec{k}\right]}{\left[\gamma^2(x - vt)^2 + y^2 + z^2\right]^{\frac{3}{2}}}$$

Now, let the permeability of free space be μ_0. Since we are discussing this in a vacuum, we have:

$$\vec{B} = \frac{\mu_0 q\gamma}{4\pi} \frac{\vec{v} \times \left[(x - vt)\vec{i} + y\vec{j} + z\vec{k}\right]}{\left[\gamma^2(x - vt)^2 + y^2 + z^2\right]^{\frac{3}{2}}}$$

$$= \frac{\mu_0 \varepsilon_0 q\gamma}{4\pi\varepsilon_0} \frac{\vec{v} \times \left[(x - vt)\vec{i} + y\vec{j} + z\vec{k}\right]}{\left[\gamma^2(x - vt)^2 + y^2 + z^2\right]^{\frac{3}{2}}}$$

$$= \mu_0 \varepsilon_0 \vec{v} \times \vec{E}$$

Since

$$\mu_0 \varepsilon_0 = \frac{1}{c^2}$$

the above equation can also be written as

$$\vec{B} = \frac{1}{c^2} \vec{v} \times \vec{E}$$

17.1 The Geometrical Definition of Magnetic Field

The electric charge q has a geometrical form, and its relation is given by:

$$q = -k'k \frac{1}{\Omega^2} \frac{d\Omega}{dt}$$

Substituting this into the magnetic field equation, we obtain the geometrical form of the magnetic field:

$$\vec{B} = -\frac{\mu_0 k'k}{4\pi} \frac{1}{\Omega^2} \frac{d\Omega}{dt} \gamma \frac{\vec{v} \times \left[(x - vt)\vec{i} + y\vec{j} + z\vec{k}\right]}{\left[\gamma^2(x - vt)^2 + y^2 + z^2\right]^{\frac{3}{2}}}$$

17.2 Polar Coordinate Form of the Magnetic Field

Let θ be the angle between the position vector $\vec{r}$ (magnitude $r = \sqrt{\gamma^2(x - vt)^2 + y^2 + z^2}$) and the velocity $\vec{v}$. The magnetic field can be written in polar coordinates as:

$$\vec{B} = -\frac{\mu_0 k'k}{4\pi} \frac{1}{\Omega^2} \frac{d\Omega}{dt} \frac{v \sin\theta}{\gamma^2 r^2 \left(1 - \beta^2 \sin^2\theta\right)^{\frac{3}{2}}} \vec{e_r}$$

where $\beta = \frac{v}{c}$, c is the speed of light, v is the speed of the particle, and $\vec{e_r}$ is the unit vector in the direction of $\vec{r}$.

17.3 Magnetic Field in Terms of Mass

Using the relation between mass and charge $q = k' \frac{dm}{dt}$, we can express the magnetic field in terms of mass:

$$\vec{B} = \frac{\mu_0 k'}{4\pi} \frac{dm}{dt} \gamma \frac{\vec{v} \times \left[(x - vt)\vec{i} + y\vec{j} + z\vec{k} \right]}{\left[\gamma^2 (x - vt)^2 + y^2 + z^2 \right]^{\frac{3}{2}}}$$

17.4 Magnetic Field and Electric Field Relationship

The magnetic field, electric field, and velocity are related by the following vector cross product:

$$\vec{B} = \frac{1}{c^2} \vec{v} \times \vec{E}$$

Breaking it into components:

$$\vec{B}_x = 0$$

$$\vec{B}_y = -\frac{1}{c^2} \vec{v} \times \vec{E}_z$$

$$\vec{B}_z = \frac{1}{c^2} \vec{v} \times \vec{E}_y$$

These equations show how the magnetic field components are formed from the cross product of the velocity and electric field components.

18 Definition of the Nuclear Force Field

Before we discuss the steps involved in creating a magnetic force field, let's start by defining what a nuclear force field is. All force fields can be understood as arising from changes in the gravitational field. Similar to the electromagnetic field, the nuclear force field can also be described in relation to changes in the gravitational field.

While the electric field is generated by changes in mass over time within the gravitational field, the nuclear force field is produced by the variation of the position vector $\vec{r}$ (with magnitude r) in the gravitational field as a function of time.

The gravitational field is expressed as:

$$A = -G\, m\, \frac{\vec{r}}{r^3} = -G\, \frac{k}{\Omega}\, \frac{\vec{r}}{r^3}$$

where G is the gravitational constant, m is the mass, and $\vec{r}$ is the position vector.

The nuclear force field is generated by the time variation of the vector $\frac{\vec{r}}{r^3}$ in the gravitational field:

$$\vec{D} = -G\, m\, \frac{d\left(\frac{\vec{r}}{r^3}\right)}{dt}$$

Expanding this, we get:

$$\vec{D} = -G\, m\, \frac{\left(\frac{d\vec{r}}{dt} - 3\,\frac{\vec{r}}{r}\,\frac{dr}{dt}\right)}{r^3}$$

Further simplifying:

$$\vec{D} = -G\, m\, \frac{\left(\vec{c} - 3\,\frac{\vec{r}}{r}\,\frac{dr}{dt}\right)}{r^3}$$

where $\vec{c}$ is the vector of light speed.

The nuclear force field is still a hypothesis and does not have established equations in current physics, unlike the well-described electric and magnetic fields. While the electric and magnetic fields are well understood, the nuclear force field remains theoretical, and its exact mathematical representation is still being investigated.

Furthermore, nuclear forces originate within the atomic nucleus between protons and neutrons, which are constantly in motion. Therefore, even if this nuclear force field equation is correct, it cannot be applied directly to static particles and must be extended to apply to moving particles.

The reliability of this nuclear force field equation and the precise formula for nuclear interactions require further theoretical exploration and experimental verification.

Regarding nuclear interactions, one hypothesis is that the nuclear force exerted by a particle of mass m on a nearby particle p of mass m' is given by the nuclear force field $\vec{D}$ produced by the particle at point p, as described by the above field equation, and is multiplied by the mass m' of particle p, or its momentum $m'\vec{v}$, or angular momentum $\vec{r} \times m'\vec{v}$.

19 Electric Fields Generated by Time-Varying Gravitational Fields

In the Unified Field Theory, gravitational fields are the primary fields, from which electric fields, magnetic fields, and nuclear forces are derived. Charge is a result of mass variation.

Conversely, changes in electric, magnetic, and nuclear fields can also generate gravitational fields, but the form of these changes is more complex, whereas changes in gravitational fields that generate other fields are simpler.

First, we will derive the electric field generated by the variation of a gravitational field when a particle at point o is stationary relative to the observer. Next, we will derive the electric field generated by the variation of the gravitational field when the particle is in motion relative to the observer.

Starting with the gravitational field equation:

$$\vec{A} = -\frac{G\ m'\ \vec{r}}{r^3} = -G\ k\ \frac{1}{\Omega}\ \frac{\vec{r}}{r^3}$$

Taking the partial derivative of $\frac{1}{\Omega}$ with respect to time t, we get:

$$\frac{\partial \vec{A}}{\partial t} = G\ k\ \frac{1}{\Omega^2}\ \frac{d\Omega}{dt}\ \frac{\vec{r}}{r^3}$$

Using the static electric field's geometric definition:

$$\vec{E} = -\frac{k'k}{4\pi\ \varepsilon_0}\ \frac{1}{\Omega^2}\ \frac{d\Omega}{dt}\ \frac{\vec{r}}{r^3}$$

We can express this as:

$$\vec{E} = -\frac{k'}{4\pi\ \varepsilon_0 G}\ \frac{d\vec{A}}{dt}$$

Since G, k', 4π, and ε_0 are constants, we can combine them into a single constant f, yielding:

$$\vec{E} = -f\ \frac{d\vec{A}}{dt}$$

This gives us the following relationships for the components:

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

$$E_y = -f\ \frac{\partial A_y}{\partial t}$$

$$E_z = -f\ \frac{\partial A_z}{\partial t}$$

Now, consider the case where the charged particle at point o is moving at a constant velocity $\vec{v}$ (with magnitude v) along the positive x-axis relative to the observer. By applying the relativistic transformations of both the electric and gravitational fields, we can derive the relationship between the moving electric field and the gravitational field.

To distinguish between them, we use primed variables to represent the electric and gravitational fields when the particle at point o is stationary, and unprimed variables to represent the fields when the particle is moving.

The relationship between the electric and gravitational fields when the particle is stationary is:

$$E'_x = -f\ \frac{\partial A'_x}{\partial t'}$$

$$E'_y = -f\ \frac{\partial A'_y}{\partial t'}$$

$$E'_z = -f\ \frac{\partial A'_z}{\partial t'}$$

From the Lorentz transformation of the electric field in special relativity, we know that:

$$E_x = E'_x, \quad E_y = \gamma\ E'_y, \quad E_z = \gamma\ E'_z$$

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

From the relativistic transformations of the gravitational field, we have:

$$A_x = \gamma\ A'_x, \quad A_y = \gamma^2\ A'_y, \quad A_z = \gamma^2\ A'_z$$

Taking the partial derivative of the Lorentz time transformation $t' = \gamma(t - \frac{vx}{c^2})$ with respect to time t, we get:

$$\frac{\partial t'}{\partial t} = \gamma \left(\frac{\partial t}{\partial t} - \frac{v^2}{c^2} \right)$$

$$\frac{\partial t'}{\partial t} = \gamma \left(1 - \frac{v^2}{c^2} \right) = \frac{\gamma}{\gamma^2} = \frac{1}{\gamma}$$

$$\frac{\partial}{\partial t'} = \gamma\ \frac{\partial}{\partial t}$$

From this, we derive the relationships between the moving electric field $\vec{E}$ and the moving gravitational field $\vec{A}$ as:

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

$$E_y = -f\ \frac{\partial A_y}{\partial t}$$

$$E_z = -f\ \frac{\partial A_z}{\partial t}$$

From the results, we observe that the relationship between the electric and gravitational fields remains the same whether the particle is at rest or moving at a constant velocity.

20 Electric Field Generated by the Changing Gravitational Field of an Object in Uniform Motion

As mentioned earlier, when the particle at point o is stationary with respect to the observer, the divergence of the surrounding gravitational field $\vec{A}'$ is:

$$\vec{\nabla} \bullet \vec{A}' = \frac{\partial A'_x}{\partial x'} + \frac{\partial A'_y}{\partial y'} + \frac{\partial A'_z}{\partial z'}$$

where A'_x, A'_y, and A'_z are the components of the gravitational field $\vec{A}'$ along the three coordinate axes.

When the particle at point o is moving with velocity $\vec{v}$ (with magnitude v) along the positive x-axis in uniform motion, the divergence of the gravitational field $\vec{A}$ is:

$$\vec{\nabla} \bullet \vec{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$$

Applying the Lorentz transformation $x' = \gamma(x - vt)$ and differentiating, we get $\frac{1}{\gamma}\frac{\partial}{\partial x} = \frac{\partial}{\partial x'}$. Then, with $\partial y = \partial y'$ and $\partial z = \partial z'$, and using the relativistic transformation of the gravitational field, we obtain:

$$\vec{\nabla} \bullet \vec{A}' = \frac{1}{\gamma}\left(\frac{\partial \frac{A_x}{\gamma}}{\partial x} + \frac{\partial \frac{A_y}{\gamma}}{\partial y} + \frac{\partial \frac{A_z}{\gamma}}{\partial z}\right)$$

Simplifying:

$$= \frac{1}{\gamma^2}\left(\frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}\right)$$

$$= \frac{1}{\gamma^2}\vec{\nabla} \bullet \vec{A}$$

Thus, we derive the following relationship:

$$\vec{\nabla} \bullet \vec{A}' = \left(1 - \frac{v^2}{c^2}\right)\vec{\nabla} \bullet \vec{A}$$

$$= \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z} - \frac{v^2}{c^2}\left(\frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}\right)$$

$$= \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z} - \frac{v}{c^2}v\left(\frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}\right)$$

Rewriting this equation in vector form, we recognize that this is a divergence, not a curl, so the equation involves the dot product of velocity $\vec{v}$ (which is along the x-axis) with the three components of the gravitational field $\vec{A}$.

$$\vec{\nabla} \bullet \vec{A}' = \left(1 - \frac{v^2}{c^2}\right)\vec{\nabla} \bullet \vec{A}$$

$$= \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z} - \frac{v}{c^2}v\left(\frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}\right)$$

This can be further expressed as:

$$\vec{\nabla} \bullet \vec{A}' = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z} - \frac{v}{c^2}\frac{\partial A_x}{\partial t}$$

Substituting the relationship between the electric field component E_x and the gravitational field component A_x (i.e., $E_x = -f\frac{\partial A_x}{\partial t}$):

$$\vec{\nabla} \bullet \vec{A}' = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z} + \frac{v}{c^2}\frac{1}{f}E_x$$

This equation shows that when a particle at point o is stationary relative to the observer, it generates a gravitational field $\vec{A}'$ in the surrounding space. When the particle moves at a velocity $\vec{v}$ along the x-axis, the gravitational field changes (denoted by $\vec{A}$), and this change splits into two parts: one part independent of velocity and the other part dependent on velocity, which manifests as the electric field along the x-axis.

Using the relationship between the gravitational field and electric field for a moving particle, we can also derive the relationship between the curl of the magnetic field and the changing gravitational field.

By substituting the relationship between the moving electric field $\vec{E}$ and the moving gravitational field $\vec{A}$:

$$\vec{E} = -f\frac{d\vec{A}}{dt}$$

into Maxwell's equation:

$$\mu_0\vec{J} + \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t} = \vec{\nabla} \times \vec{B}$$

we obtain:

$$\mu_0\vec{J} - \frac{f}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} = \vec{\nabla} \times \vec{B}$$

Here, $\vec{J}$ represents the current generated by the motion of a charge with density ρ along the x-axis with velocity $\vec{v}$:

$$\mu_0\vec{J} = \mu_0\varepsilon_0\frac{\vec{v}\rho}{\varepsilon_0} = \frac{1}{c^2}\frac{\vec{v}\rho}{\varepsilon_0}$$

Therefore, we can rewrite $\mu_0\vec{J}$ as:

$$\frac{\vec{v}}{c^2}\vec{\nabla} \bullet \vec{E}$$

Thus, the equation becomes:

$$\frac{\vec{v}}{c^2}\vec{\nabla} \bullet \vec{E} - \frac{f}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} = \vec{\nabla} \times \vec{B}$$

Simplifying:

$$\frac{f}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} = \frac{\vec{v}}{c^2}\vec{\nabla} \bullet \vec{E} - \vec{\nabla} \times \vec{B}$$

$$\frac{\partial^2 \vec{A}}{\partial t^2} = \frac{1}{f}\vec{v}\left(\vec{\nabla} \bullet \vec{E}\right) - \frac{c^2}{f}\vec{\nabla} \times \vec{B}$$

This equation shows that a changing gravitational field can generate both electric and magnetic fields. This behavior is analogous to Maxwell's equations, suggesting that gravitational fields can be incorporated into Maxwell's equations as an extended form.

21 Gravitational Field Generated by the Magnetic Field of a Moving Charge

21.1 Gravitational Field Generated by the Magnetic Field of a Uniformly Moving Charge

In unified field theory, a key principle is that a changing gravitational field can generate an electric field. Conversely, a changing electromagnetic field can also generate a gravitational field.

Relativity and electromagnetism suggest that a moving charge not only generates an electric field but also produces a magnetic field. Unified field theory extends this by suggesting that a moving charge also generates a gravitational field. We will now derive the relationship between the electromagnetic field and the gravitational field generated by a moving charge.

As discussed earlier, the gravitational field generated by a changing gravitational field points in the same direction as the electric field, whereas the electric field is generally perpendicular to the magnetic field. Therefore, the gravitational field is also generally perpendicular to the magnetic field.

We will explore the relationship between the curl of the gravitational field and the magnetic field, as the curl describes how a field changes along the perpendicular direction, while divergence describes changes along the parallel direction.

Imagine a point charge at point o, starting from the origin at time zero and moving along the positive x-axis at a constant velocity $\vec{v}$ (with magnitude v) relative to the observer. The point charge at point o generates an electric field $\vec{E}$, a magnetic field $\vec{B}$, and a gravitational field $\vec{A}$ at a surrounding point p, as shown below.

Let's use the point p in space as our reference point and analyze the situation.

The gravitational field $\vec{A}$ and the electric field $\vec{E}$ both spiral in the same direction, forming a left-hand helix. However, at any point on the spiral, $\vec{A}$ and $\vec{E}$ are perpendicular to each other.

To prove that the electric field $\vec{E}$, the magnetic field $\vec{B}$, and the gravitational field $\vec{A}$ satisfy the relationships depicted in the figure, let's first compute the curl of $\vec{A}$:

$$\vec{\nabla} \times \vec{A} = \left(\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z}\right)\vec{i} + \left(\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x}\right)\vec{j} + \left(\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y}\right)\vec{k}$$

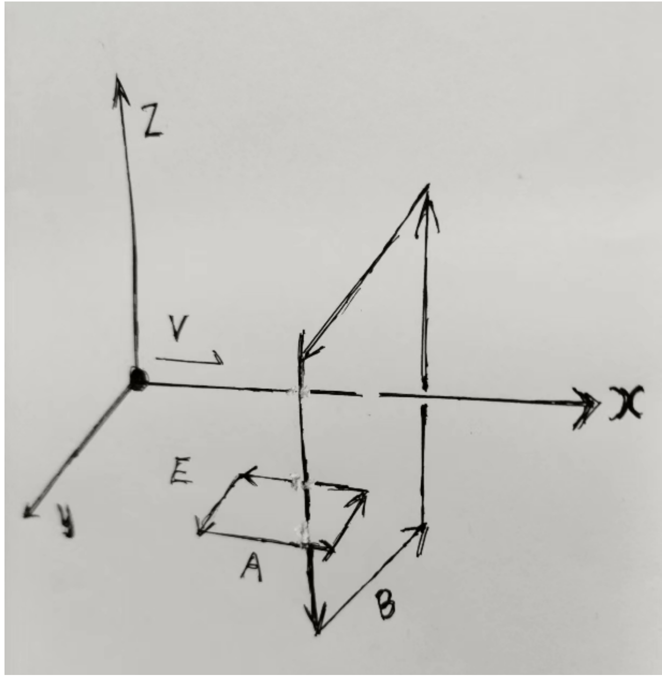


Figure 5: Electromagnetic and Gravitational Fields of a Moving Charge

For a stationary object, the curl of the gravitational field is zero, i.e., $\vec{\nabla} \times \vec{A'} = 0$, which gives the following component equations:

$$\frac{\partial A'_z}{\partial y'} - \frac{\partial A'_y}{\partial z'} = 0$$
$$\frac{\partial A'_x}{\partial z'} - \frac{\partial A'_z}{\partial x'} = 0$$
$$\frac{\partial A'_y}{\partial x'} - \frac{\partial A'_x}{\partial y'} = 0$$

Using the relativistic transformation of the gravitational field, we get:

$$0 = \frac{1}{\gamma^2}\left(\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z}\right)$$

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

Thus:

$$\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} = 0$$

For the Lorentz transformation $x' = \gamma(x - vt)$, differentiating gives:

$$\frac{1}{\gamma}\frac{\partial}{\partial x} = \frac{\partial}{\partial x'}$$

Using the relativistic transformation of the gravitational field, we obtain:

$$\frac{1}{\gamma}\frac{\partial A_x}{\partial z} - \frac{1}{\gamma^3}\frac{\partial A_z}{\partial x} = 0$$

Thus:

$$\frac{\partial A_x}{\partial z} - \frac{1}{\gamma^2}\frac{\partial A_z}{\partial x} = 0$$

or:

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

Since $v\frac{\partial}{\partial x} = \frac{\partial}{\partial t}$, we get:

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

Using:

$$\frac{\partial A'_y}{\partial x'} - \frac{\partial A'_x}{\partial y'} = 0$$

and the relativistic transformation of the gravitational field, we have:

$$\frac{1}{\gamma^3}\frac{\partial A_y}{\partial x} - \frac{1}{\gamma}\frac{\partial A_x}{\partial y} = 0$$

Thus:

$$\frac{1}{\gamma^2}\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = 0$$

or:

$$\left(1 - \frac{v^2}{c^2}\right)\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = 0$$

and:

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

Since $v\frac{\partial}{\partial x} = \frac{\partial}{\partial t}$, we get:

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

From the earlier relationships between the gravitational field and the electric field of a moving object:

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

$$E_y = -f\frac{\partial A_y}{\partial t}$$

$$E_z = -f\frac{\partial A_z}{\partial t}$$

we get:

$$\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} = 0$$

$$\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} = \frac{v}{c^2}\frac{1}{f}E_z$$

$$\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = -\frac{v}{c^2}\frac{1}{f}E_y$$

From previous discussions, when a charge moves along the positive x-axis at velocity $\vec{v}$, the relationship between the components of the electric field $\vec{E}$, the magnetic field $\vec{B}$, and the gravitational field $\vec{A}$ is given by:

$$B_x = 0$$

$$B_y = \frac{v}{c^2}E_z$$

$$B_z = -\frac{v}{c^2}E_y$$

Thus, we have:

$$\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z} = B_x$$

$$\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x} = \frac{1}{f}B_y$$

$$\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y} = \frac{1}{f}B_z$$

By combining these equations, we obtain the fundamental relationship between the curl of the gravitational field $\vec{A}$ and the magnetic field $\vec{B}$:

$$\vec{\nabla} \times \vec{A} = \frac{1}{f}\vec{B}$$

This is the fundamental relationship between the magnetic field and the gravitational field. It shows that the magnetic field produced by a charge moving at a constant velocity can be represented as the curl of the gravitational field.

At any given instant (due to the unification of space-time, or at a specific point in space), the magnetic field, electric field, and gravitational field are mutually perpendicular.

This equation could provide the ultimate explanation for the Aharonov-Bohm (AB) effect in quantum mechanics.

If we take the equation $\vec{\nabla} \times \vec{A} = \frac{1}{f}\vec{B}$ and dot it with the infinitesimal area element $d\vec{S}$ (which can be considered a small area on a Gaussian surface $s = 4\pi r^2$ surrounding the point charge at o), and then apply Stokes' theorem from field theory, we obtain the integral form of the relationship between the magnetic field $\vec{B}$ and the gravitational field $\vec{A}$:

$$\oint \vec{A} \cdot d\vec{l} = \frac{1}{f} \iint \vec{B} \cdot d\vec{S}$$

21.2 Magnetic Field Changing Over Time Produces Electric and Gravitational Fields

Consider a point charge at point o starting from the origin at time zero. It moves along the positive x-axis with a uniform velocity $\vec{v}$ (with magnitude v) relative to the observer. The point charge o generates a moving electric field $\vec{E}$ and a uniform magnetic field $\vec{B}$ at any spatial point p:

$$\vec{B} = \frac{1}{c^2}\, \vec{v} \times \vec{E}$$

When the point charge o accelerates along the positive x-axis with an acceleration $-\vec{A}$, it generates a moving electric field $\vec{E}$, a time-varying magnetic field $\frac{d\vec{B}}{dt}$, and a gravitational field $\vec{A}$ at any spatial point p.

At point p, let's differentiate the magnetic field equation $\vec{B} = \frac{1}{c^2}\, \vec{v} \times \vec{E}$ with respect to time t:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\, \frac{d\vec{v}}{dt} \times \vec{E} + \frac{1}{c^2}\, \vec{v} \times \frac{d\vec{E}}{dt}$$

If we can prove that:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\, \vec{v} \times \frac{d\vec{E}}{dt}$$

this represents the magnetic field change generating an electric field, which is Faraday's law of electromagnetic induction. Conversely,

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\, \frac{d\vec{v}}{dt} \times \vec{E}$$

should represent the changing magnetic field generating a gravitational field. Since $\frac{d\vec{v}}{dt} = \vec{A}$ is the acceleration at point p, and according to unified field theory, spatial acceleration is equivalent to the gravitational field.

We first prove that:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\,\vec{v} \times \frac{d\vec{E}}{dt}$$

is indeed Faraday's law of electromagnetic induction.

Since the point of consideration is not at o, but at point p, the relationship between the magnetic field $\vec{B}$ and the electric field $\vec{E}$ is a left-handed spiral:

$$B_x = 0$$

$$B_y = \frac{v}{c^2}E_z$$

$$B_z = -\frac{v}{c^2}E_y$$

Now differentiating $\frac{d\vec{B}}{dt} = \frac{1}{c^2}\,\vec{v} \times \frac{d\vec{E}}{dt}$ with respect to time t, we get the following components (replacing d with partial derivatives ∂):

$$\frac{\partial B_x}{\partial t} = 0$$

$$\frac{\partial B_y}{\partial t} = \frac{v}{c^2}\,\frac{\partial E_z}{\partial t}$$

$$\frac{\partial B_z}{\partial t} = -\frac{v}{c^2}\,\frac{\partial E_y}{\partial t}$$

From the fact that the curl of a static electric field is zero:

$$\frac{\partial E'_x}{\partial z'} - \frac{\partial E'_z}{\partial x'} = 0$$

and using the Lorentz transformation:

$$E_x = E'_x\,,\;\; \partial z' = \partial z\,,\;\; E'_z = \frac{1}{\gamma}E_z\,,\;\; \frac{\partial}{\partial x'} = \frac{1}{\gamma}\frac{\partial}{\partial x}\,,\;\; \gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$$

we get:

$$\frac{\partial E_x}{\partial z} - \frac{1}{\gamma^2}\frac{\partial E_z}{\partial x} = 0$$

or:

$$\frac{\partial E_x}{\partial z} - \left(1 - \frac{v^2}{c^2}\right)\frac{\partial E_z}{\partial x} = 0$$

Thus:

$$\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x} = -\frac{v^2}{c^2}\frac{\partial E_z}{\partial x}$$

Since $v\frac{\partial}{\partial x} = \frac{\partial}{\partial t}$, we get:

$$\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x} = -\frac{v}{c^2}\frac{\partial E_z}{\partial t}$$

By following similar steps, we can obtain:

$$\frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y} = \frac{v}{c^2}\ \frac{\partial E_y}{\partial t}$$

By comparing these results with:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\ \vec{v} \times \frac{d\vec{E}}{dt}$$

we get the following components:

$$\frac{\partial B_x}{\partial t} = 0$$

$$\frac{\partial B_y}{\partial t} = \frac{v}{c^2}\ \frac{\partial E_z}{\partial t}$$

$$\frac{\partial B_z}{\partial t} = -\frac{v}{c^2}\ \frac{\partial E_y}{\partial t}$$

Thus, we obtain:

$$\frac{\partial E_z}{\partial y} - \frac{\partial E_y}{\partial z} = 0$$

$$\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x} = -\frac{\partial B_y}{\partial t}$$

$$\frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y} = -\frac{\partial B_z}{\partial t}$$

Combining these three equations yields Faraday's law of electromagnetic induction:

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

Next, we analyze the equation for the changing magnetic field $\vec{B}$ generating the gravitational field $\vec{A}$, represented by:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\ \frac{d\vec{v}}{dt} \times \vec{E}$$

The components of this equation are as follows:

$$\frac{\partial \vec{B}_x}{\partial t} = 0$$

$$\frac{\partial \vec{B}_y}{\partial t} = \frac{1}{c^2}\,\frac{\partial \vec{v}}{\partial t} \times \vec{E}_z = \frac{1}{c^2}\,\vec{A} \times \vec{E}_z$$

$$\frac{\partial \vec{B}_z}{\partial t} = -\frac{1}{c^2}\,\frac{\partial \vec{v}}{\partial t} \times \vec{E}_y = -\frac{1}{c^2}\,\vec{A} \times \vec{E}_y$$

These equations can be written as:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\,\vec{A} \times \vec{E}$$

This equation can be interpreted as follows:

When a positively charged particle at point o accelerates along the positive x-axis, it generates a changing magnetic field $\frac{d\vec{B}}{dt}$, an electric field $\vec{E}$, and a gravitational field $\vec{A}$ in the opposite direction to the acceleration.

The vectors $\vec{A}$, $\vec{E}$, and $\frac{d\vec{B}}{dt}$ are related by a cross product, and their values are maximized when the vectors are mutually perpendicular.

21.3 The Relationship Between Electric, Magnetic, and Gravitational Fields of an Accelerating Charge

Since the production of gravitational fields from changing electromagnetic fields is the core concept of unified field theory and crucial for artificial field technologies, let us derive the gravitational field produced by an accelerating positive charge using an alternative method.

The relationships between the electric field, magnetic field, and gravitational field can be seen as extensions of the fundamental equation for magnetic fields, $B = \frac{V \times E}{c^2}$, and can all be derived from this basic equation.

The equation $\frac{dB}{dt} = \frac{A \times E}{c^2}$ is applicable to certain microscopic fundamental particles, but for macroscopic particles, which consist of many tiny charged particles, the positive and negative charges largely cancel out, and much of the magnetic field cancels out as well.

The previously derived formula for the generation of gravitational fields by changing magnetic fields, $\frac{dB}{dt} = \frac{A \times E}{c^2}$, may apply only to positive charges. This is because the spatial light speed around a positive charge disperses outward, allowing the spatial distortion effect (which includes the accelerated electric field, accelerated magnetic field, and changing electric field forming the gravitational field) to propagate outward at the speed of light.

In contrast, the spatial light speed around a negative charge converges inward, meaning it cannot, in principle, radiate spatial distortion effects outward. However, according to Lorentz transformations, the space contracted by the speed of light is reduced to zero, making it unobservable in our frame. Thus, whether this formula applies to negative charges requires further theoretical investigation and experimental validation.

To further understand the relationship between the electric, magnetic, and gravitational fields of an accelerating charge, let us analyze a specific example.

Consider a stationary point charge o, carrying a positive charge q, which generates a static electric field E at a spatial point p.

At time zero, the point charge o suddenly accelerates in the positive x-direction with a vector acceleration G (magnitude g) relative to the observer.

According to unified field theory, the acceleration of point o causes the spatial point p to move outward from o with a vector speed C and an additional acceleration of $-G$.

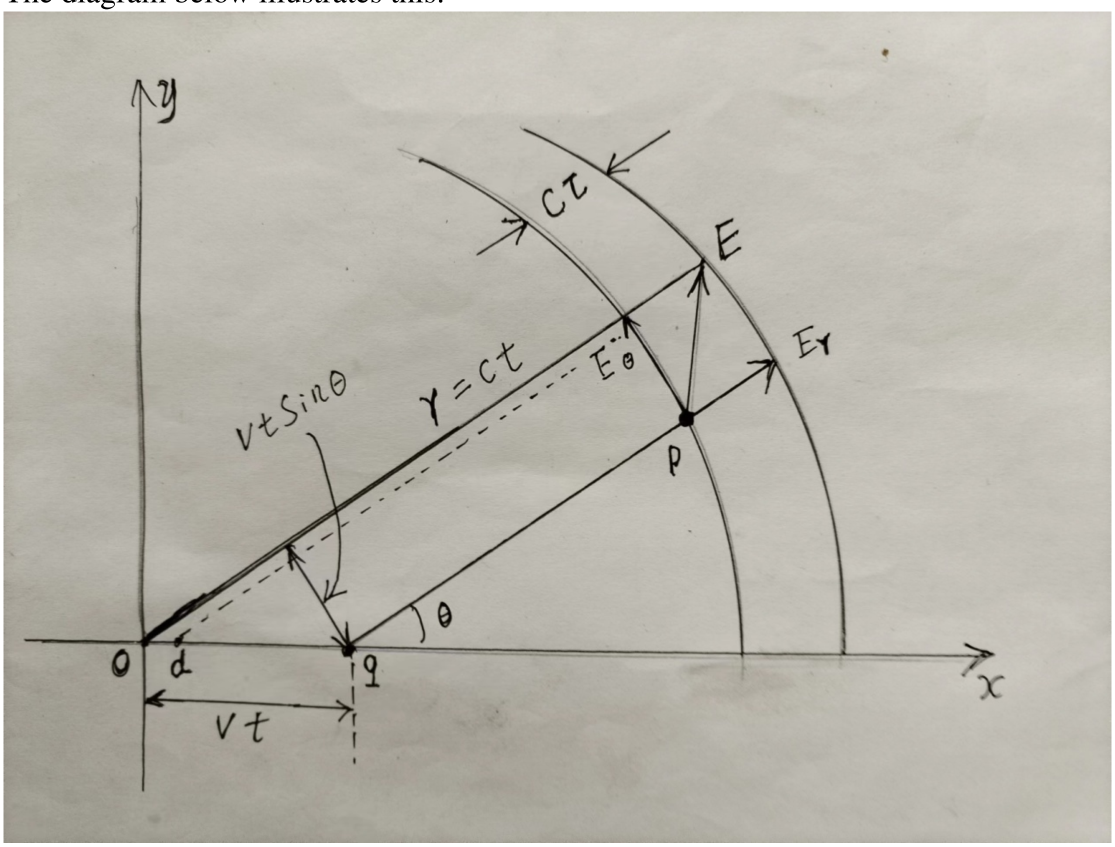
The gravitational field in unified field theory is defined as the acceleration of the spatial point itself. The gravitational field A (magnitude a) is equivalent to the acceleration of the spatial point p, $-G$, so point p experiences a gravitational field due to the acceleration of point o: $A = -G$.

Next, we derive the relationship between the static electric field E_r, the distorted accelerating electric field E_θ, and the gravitational field A.

Imagine a positive point charge o that remains stationary at the origin of a Cartesian coordinate system, and from time $t = 0$, it begins to accelerate in the positive x-direction with an acceleration G (magnitude g).

At time $t = \tau$, point o reaches point d, stops accelerating, and continues to move with a velocity $v = g\tau$ along the x-axis, reaching point q.

The diagram below illustrates this:



For simplicity, let's assume that v is much smaller than the speed of light c, and the distance od is much smaller than oq.

Now, let's consider the distribution of the electric field around charge o at any time t (where t is much larger than τ).

From time zero to time τ, the accelerated motion of the charge o distorts the electric field lines around it, and this distortion propagates outward at the speed of light c.

Unified field theory points out that the electric field lines of a positive charge represent the displacement of spatial points around the charge moving at the speed of light.

The distortion propagates outward at the speed of light, similar to how a slight shake of a water hose spraying uniformly in all directions causes the water stream to distort and propagate outward at the speed of the water.

The distorted electric field caused by the accelerated charge o propagates outward at the speed of light c. In the diagram, the thickness of the distortion region is $c\tau$, situated between two spherical surfaces.

The rear spherical surface, centered at point q, has a diameter of $c(t-\tau)$ at time t, while the front spherical surface, centered at point o, has a diameter of ct.

From time $t=\tau$, charge o moves at a constant speed, so the electric field inside the sphere of diameter $c(t-\tau)$ should correspond to that of a uniformly moving charge.

Since we assume that the velocity v is much smaller than the speed of light c, the electric field within the sphere at any moment can be approximated as a static electric field.

At time t, the electric field lines are straight, extending radially from the position q of charge o.

Given that t is much larger than τ and that c is much larger than v, we have $r=ct$, which is much larger than the distance $v\tau/2$ (the distance from point o to point d). Therefore, the two spherical surfaces in the distorted region are almost concentric.

As time passes, the radius ct of the distortion grows continuously, propagating outward at the speed of light.

From unified field theory, we know that electric field lines remain continuous, even when distorted, so the number of electric field lines on the front and back sides of the distortion region remains the same.

When v is much smaller than c, the distorted electric field lines can be treated as straight.

Let's analyze one electric field line at an angle θ to the x-axis.

Since the distance od is much smaller than $r=ct$, we can consider points o and d as nearly coincident (i.e., $od\approx 0$).

The distance oq is given by $oq=v\tau/2+v(t-\tau)=vt$.

In the distorted region, the electric field E can be divided into two components: the radial electric field E_r (which exists when the charge is stationary, with magnitude e_r) and the transverse electric field E_θ (which can be considered as the variation of E_r, with magnitude e_θ).

From the diagram, we can deduce the following relationship:

$$\frac{e_\theta}{e_r}=\frac{vt\sin\theta}{c\tau}=\frac{gt\sin\theta}{c}=\frac{gr\sin\theta}{c^2}$$

In unified field theory, the gravitational field is essentially the acceleration of the spatial point itself. However, the gravitational field is in the opposite direction to the position vector R (with magnitude r) from the gravitational source to the point where the field is measured.

Thus, the gravitational field A (with magnitude $a=-g$) can be expressed as:

$$\frac{E_\theta}{e_r} = \frac{A \times R}{c^2}$$

In this equation, the distance $r = ct$ is replaced by the vector R, representing the position from point o to point p.

The transverse electric field E_θ is perpendicular to the direction of electromagnetic wave propagation (here, the direction of E_r) and exists only in the distorted region. Hence, it is the transverse distorted electric field generated by the accelerating motion of charge o.

The transverse electric field E_θ can be considered a result of the change in E_r due to the acceleration of the charge.

This equation provides the relationship between the static electric field E_r of charge o, the variation of E_r due to acceleration (E_θ), and the gravitational field A generated by the accelerating charge.

Next, we derive the relationship between the changing magnetic field and the gravitational field generated by the accelerating charge.

According to Maxwell's equations, a changing electric field in a vacuum must generate a changing magnetic field.

Unified field theory and relativity both assert that the electric field E and the magnetic field $\vec{B}$ of a charge moving at velocity v satisfy the fundamental relationship:

$$B = \frac{V \times E}{c^2}$$

For the changing transverse electric field E_θ and the transverse magnetic field B_θ (with magnitude b_θ) produced by the accelerated charge, the same relationship holds:

$$B = \frac{V \times E}{c^2}$$

However, in this case, the velocity v does not refer to the velocity of the charge, but rather to the velocity of the spatial point p around the charge (which can also be called the field point or observation point).

Unified field theory asserts that any spatial point around a stationary object moves outward at the speed of light C'. When the object moves at velocity v, the velocity of the spatial point becomes $C - V$. Thus, the speed C' of the spatial point and the speed C differ by an amount v.

Since the velocity v of the charge is much smaller than the speed of light, the velocity of the spatial point p can still be approximated as the vector speed of light C.

Given that the distortion propagates at the speed of light, and considering the vector speed of light concept in unified field theory, the velocity of the spatial point is the vector speed of light C. Therefore, we have:

$$B_\theta = \frac{C \times E_\theta}{c^2}$$

In scalar form, this becomes:

$$cb_\theta = e_\theta$$

By comparing this equation with $\frac{E_\theta}{e_r} = \frac{A\times R}{c^2}$ (where e_r is the magnitude of E_r), we obtain:

$$\frac{B_\theta}{e_r} = \frac{A \times R}{c^3}$$

This equation expresses the relationship between the static electric field E_r (with magnitude e_r) of a stationary charge, the gravitational field A generated by the accelerated charge, and the changing magnetic field B_θ.

Using the spacetime unification equation $R = Ct$, we can rewrite the equation $\frac{B_\theta}{e_r} = \frac{A\times R}{c^3}$ as:

$$B_\theta = e_r \frac{A \times \hat{R}}{c^2} t$$

Here, $\hat{R}$ is the unit vector of R, which is aligned with C, and the direction of e_r is also aligned with $\hat{R}$, so:

$$e_r \hat{R} = E_r$$

Thus, we have:

$$B_\theta = \frac{(A \times E_r)}{c^2} t$$

Taking the time derivative of both sides, we get:

$$\frac{dB_\theta}{dt} = \frac{A \times E_r}{c^2}$$

In fact, this equation is consistent with the time derivative of the fundamental magnetic field equation $B = \frac{V\times E}{c^2}$:

$$\frac{dB}{dt} = \frac{dV}{dt} \times \frac{E}{c^2} = \frac{A \times E}{c^2}$$

In words, this equation describes how an accelerating positive charge generates a gravitational field in the opposite direction of the acceleration, which propagates outward at the speed of light.

It is evident that the equation for changing electromagnetic fields generating both changing electric and gravitational fields is a natural extension of the basic relationship between magnetic and electric fields, $B = \frac{V\times E}{c^2}$. All relationships between the electric field, magnetic field, and gravitational field are essentially variants of this fundamental equation.

The above description shows that the accelerated motion of a positive charge causes a change in the electric field, producing both a changing magnetic field and a gravitational field. The relationship between the accelerated changing electric field, the changing magnetic field, and the gravitational field (including their directions) is provided.

22 Photon Model

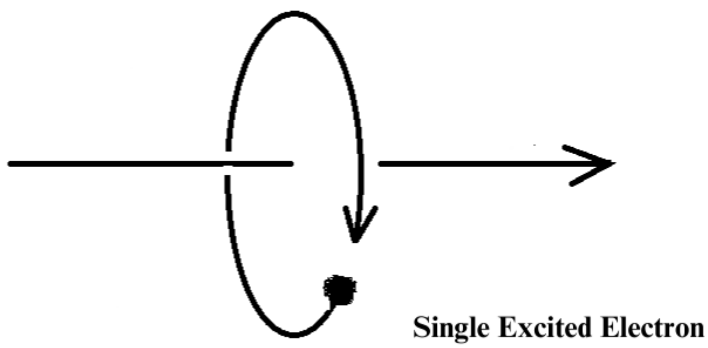
An accelerating charge relative to our observer will produce an accelerating electromagnetic field in the surrounding space. This accelerating electromagnetic field can generate an anti-gravitational field, which can cause the disappearance of the mass and charge of the accelerating charge or nearby electrons. And we would like to call it "Light Speed Electron" specifically.

When the mass and charge of an electron disappear and become a light speed electron, it causes the surrounding force field and electromagnetic properties to vanish, resulting in excitation that propagates outward at the speed of light. This phenomenon is known as an electromagnetic wave, or light.

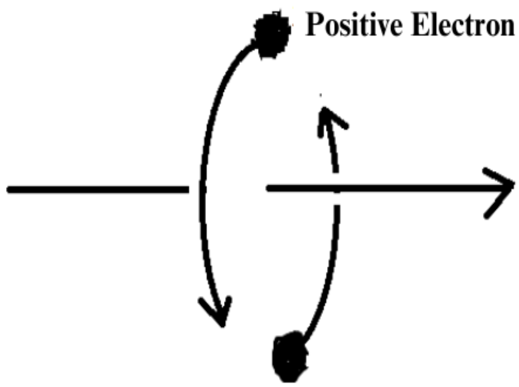
So theoretically, on the layer of space, you would see photons and light speed electrons existing simultaneously since both of them are now at the speed of light.

The photon model can be described in two ways:

1. The first type involves a single excited electron moving helically away from the observer, with the center of rotation forming a straight line. In the direction of this line, the speed is the speed of light. We call it First Type Photon.



2. The second type involves two excited electrons rotating around a straight line while simultaneously moving parallel to this line at the speed of light. As a result, the motion forms a cylindrical helical pattern moving away from the observer, with the two electrons being symmetric about the line in the perpendicular direction. We call it Second Type Photon.



The momentum of a photon is given by $\vec{p} = m\,\vec{c}$,

where m is the photon's mass in motion, and $\vec{c}$ is the vector speed of light. The photon's rest momentum and rest mass are both zero.

The energy of a photon in motion is $E = m\,c^2$.

An electron, when subjected to the mass-increasing force $(\vec{c} - \vec{v})\ \frac{dm}{dt}$, reaches an excited state where its rest mass becomes zero. This state is the photon, which always moves at the speed of light relative to the observer.

In the universe, any particle is surrounded by space that expands outward at the speed of light, with the particle at its center. Essentially, the photon is stationary in space, moving along with it.

The particle nature of the photon arises because it is composed of excited electrons, while its wave nature is due to the oscillation of space itself. Space is constantly oscillating, and the speed of this oscillation is the speed of light.

23 Limitations

Physics is our interpretation of the movement of objects and space, as we observe them. It is created through the brain's explanation. The physical world that we see and sense does not exist on its own without us as observers. What truly exists is the geometric world that lies beneath it, consisting of objects and space.

The geometric world is more closely connected to the beginning of the universe, whereas the physical world is primarily a representation and interpretation of the geometric world by our brain as an observer.

Understanding the Photon Model requires us to overlook the geometric principles behind it. This idea has been discussed with many others, but some may not believe it due to our tendency to only believe what we can see and feel with our senses.

Without an observer, or without specifying which observer, it is impossible to determine whether objects and spaces are in motion or at rest. It is pointless to discuss motion or rest. Choosing a reference object to describe motion is sometimes unreliable.

In Unified Field Theory, time is formed by the observer's own movement in space and is definitely related to the observer's movement. In other words, the measurement of time is related to the observer. The time experienced by the same thing may have different results for observers moving differently. Since space itself is constantly moving, spatial displacement is also related to the observer's movement, and different observers may have different results.

24 Conclusion

Currently, we are in the Fourth Industrial Revolution, which involves the combination of AI, robotics, and biotechnology within a digital-physical continuum. Looking forward, we may see a Fifth Industrial Revolution - a Light Speed Revolution - focusing on pioneering technological advances that enable travel at the speed of light physically, whether inside or outside of the Earth much more easily.

25 Appendix A: Phenomenons

25.1 Wave – Particle Duality

In Unified Field Theory (UFT), a double-slit interference experiment, a single particle such as a photon or an electron is assumed by the UFT to interact with the surrounding evanescent space as it passes through the double-slit. The particle contains the evanescent properties of the space around it, showing that it is intimately connected to the spatial field around it. As the particle approaches the double slit, its motion is influenced by the evanescent fields in space.

According to the UFT, the behavior of a particle can be understood as the overall effect formed by its interaction with the surrounding evanescent space. When a particle passes through a double slit, its evanescent spatial field interacts with the space between the slits, similar to the superposition of waves in conventional physics. The spatial fields interfere with each other, resulting in enhanced field strengths in some regions and weakened field strengths in others, forming interference fringes on the screen.

In the UFT interpretation, when a particle passes through a double slit, it does not simply pass through in a straight line, but interacts with the entire evanescent spatial field. This interaction determines the final position of the particle and the formation of the interference pattern. Even a single particle is affected by the entire evanescent space, and its path is not deterministic but probabilistic, explaining why even a single particle can form interference fringes on the screen in a double-slit interference experiment.

When a detector is placed in a double-slit interference experiment to measure which slit a particle passes through, the presence of the detector changes the structure of the evanescent spatial field according to the UFT, thereby affecting the behavior of the particle. As the detector attempts to probe the location of the particle, the interaction between the detector and the evanescent space field results in a localized collapse of the space field. This collapse removes the fluctuations, causing the particles to exhibit classical particle behavior and leading to the disappearance of the interference pattern.

In UFT, the double-slit interference experiment can be interpreted as a result of the interaction of the particle with the evanescent spatial field. The formation of the interference pattern is a direct consequence of the interaction of the particle with the evanescent field in the surrounding space as it passes through the double slit. When the particle is detected, the structure of the evanescent field changes, leading to the disappearance of the fluctuating behavior and the manifestation of classical particle properties. Therefore, the interference phenomenon is not only a result of the fluctuating nature of the particle, but also a manifestation of the complex interaction between the particle and the dynamic evanescent space, according to the UFT.

25.2 Quantum Entanglement

In Unified Field Theory (UFT), the phenomenon of quantum entanglement can be explained by the theory of vectorial light-speed divergence in space. In UFT, space is not static, but moves in all directions at the speed of light with particles at the center. This spatial divergence incorporates changes in the electric, magnetic and gravitational fields, and the interaction of these fields may be the key to explaining quantum entanglement.

A central problem with quantum entanglement is that when two particles are entangled, their states change in one place in space when the state of another particle far away is instantaneously synchronized, which seems to violate the speed-of-light limit. However, in the UFT perspective, entangled particles do not necessarily need to be signaled in the traditional sense, but rather are instantaneously "connected" through the divergent space they share.

Specifically, when we talk about changes of state of entangled particles, these particles may be located in the same structure of evanescent space, which, according to UFT, evanesces at the speed of vector light, implying that the entangled particles are somehow located in the same interacting evanescent spatial field. When a particle changes state, the change is not propagated by conventional signalling, but by a tuning of the entire spatial field to instantaneously affect another particle. In other words, the phenomenon of quantum entanglement may not be caused by instantaneous communication between particles, but rather by their common location in a unified evanescent spatial field, which itself is instantaneously adjusting.

In the UFT perspective, the spatially dispersive vector speed of light provides each particle with a "field" that connects it to other particles. When a particle changes state, the entire dispersive space realigns, and this realignment is instantaneous because the spatial dispersion occurs at the speed of light. This readjustment does not need to be propagated through conventional signals but is based on the overall structure of the field to act instantaneously on the entangled two particles.

Thus, the UFT interpretation of quantum entanglement can be thought of as the particles are not transmitting information through proximity, but are in the same evanescent spatial structure, where their states are part of the spatial field, and where the overall evanescent and tuning of the space results in an instantaneous change of the entangled state.

To summarize, quantum entanglement in UFT may be explained by the vector light-speed divergence of space. Since space is dynamically evanescent and entangled particles share an evanescent field, when the state of one particle changes, the whole evanescent spatial field adjusts, leading to an instantaneous change in the state of the other particle, which is also closely related to the unified field structure of space and particles in UFT.

25.3 Gravitational Lensing

In the framework of Unified Field Theory (UFT), gravitational lensing is explained through the interaction between electromagnetic fields and gravitational fields. According to UFT, varying electromagnetic fields generate gravitational fields, which can be understood as a type of "distortion" or "curvature" in space itself. Massive celestial bodies like stars and galaxies contain strong electromagnetic fields due to the presence of numerous charged particles. These fields create gravitational fields around the objects, influencing the behaviour of nearby photons or light-speed electrons.

As these photons, or what UFT refers to as "light-speed electrons," travel through the gravitational field of a massive object, their paths are bent not by direct interaction with gravity as a force but due to the change in the spatial structure caused by the electromagnetic field-induced gravitational field. This bending occurs because the gravitational field alters the nature of space itself, thereby affecting the trajectory of the photons.

In UFT, gravitational fields are seen as resulting from changes in the electromagnetic fields, and this interplay causes space to "twist" or "warp." When light from a distant source passes near a massive object, it travels through this warped space, resulting in the gravitational lensing effect observed as bent paths, multiple images, arcs, or Einstein rings.

Mathematically, while UFT does not explicitly use a metric tensor as in General Relativity to describe the curvature of spacetime, it does imply that the photon's momentum and energy are affected by the electromagnetic fields around massive bodies. These fields generate gravitational effects that influence the photon's path by changing the properties of space. This theory suggests that gravitational lensing is fundamentally a consequence of electromagnetic and gravitational field interactions, with the electromagnetic fields giving rise to gravitational fields that subsequently bend the paths of light. Thus, UFT provides a unique perspective on gravitational lensing, attributing it to the way electromagnetic fields generate and interact with gravitational fields, which then alter the course of photons moving through space.

25.4 Absolute Zero

In Unified Field Theory (UFT), the thermal motion of a matter particle can be considered as the interaction of the particle with the surrounding evanescent space. This interaction is not only embodied in the mechanical vibration of the particle, but also includes the interaction of the particle with the electromagnetic and gravitational fields in space. When the temperature decreases, the kinetic energy of the particle decreases, which means that the interaction of the particle with the surrounding evanescent space gradually weakens.

Absolute zero (0 K) is defined as the lowest point of the thermodynamic temperature scale, a theoretical limiting temperature. At this temperature, conventional physics assumes that the thermal motion of particles stops completely and that all atoms and molecules are in a state of minimum energy. However, under the UFT interpretation, absolute zero can be understood as a state in which the interaction of particles with the surrounding evanescent space field is minimized. At this point, the particle almost no longer exchanges kinetic energy with the evanescent space, and the effect of the evanescent motion of space on the particle is minimized.

Even at absolute zero, according to quantum mechanics, particles still have zero-point energy and cannot be completely stationary. This zero-point energy can be interpreted as the most fundamental interaction of the particle with the surrounding space in the lowest energy state. Even in the state closest to absolute zero, the particle still has a weak interaction with the evanescent space field, which is reflected in the zero-point vibration of the particle.

In UFT, absolute zero can be regarded as a state of extreme equilibrium between the particle and the surrounding evanescent space field. In this equilibrium state, the particle no longer absorbs energy from the space field and no longer radiates energy outward. This state of equilibrium corresponds to a minimization of the energy exchange, bringing the kinetic energy of the particle close to zero, which is reflected in the minimization of the temperature.

In the framework of unified field theory, absolute zero not only means that the thermal motion of the particle stops, but also means that the interaction of the particle with the surrounding evanescent spatial field has reached a minimized state. Even at absolute zero, the particle still exists in the evanescent space field and has zero-point energy, which reflects the most fundamental interaction between the particle and the space field. This interpretation expands the understanding of absolute zero, not only from the point of view of the kinetic energy of the particle, but also considering the relationship between the particle and the dynamical space field.

25.5 Black-Hole

In Unified Field Theory (UFT), the formation and properties of black holes can be explained through the interaction of matter particles with space divergence and the concept of gravitational fields. UFT posits that black holes are a phenomenon where space transitions from divergence to extreme convergence due to a strong gravitational field, offering insights into the formation, information loss, and related phenomena of black holes.

Under UFT, black holes are formed through the collapse of matter under extreme gravitational forces. When a massive star exhausts its nuclear fuel and loses internal radiation pressure, matter particles collapse towards the center under the force of gravity. In UFT, this is interpreted as the imbalance between matter particles and the surrounding space divergence, leading to a strong spatial convergence towards the center, forming an extremely strong gravitational field.

During this process, the convergence of space increases, eventually forming a gravitational singularity. At this singularity, all matter and energy are compressed into an infinitely small point, resulting in extreme curvature of spacetime. This extreme gravitational field prevents light and matter particles from escaping, forming the event horizon of a black hole. The event horizon is a critical boundary where the speed of convergence of space reaches the speed of light, trapping all information and matter within the black hole.

Inside a black hole, the divergent nature of space is suppressed by the extreme gravitational field, turning into intense spatial convergence. UFT proposes that this convergence causes the apparent loss of information and matter, as observed from outside the event horizon. However, UFT provides an alternative explanation: the black hole does not truly destroy information; instead, it converts it into a unique spatial state. In this state, information exists in the form of spatial convergence, which is unobservable from the outside but not truly lost.

The event horizon of a black hole is where the speed of spatial convergence equals the speed of light, preventing any matter or photons from escaping. UFT suggests that this creates an insurmountable barrier for information transmission. However, through the mechanism of Hawking radiation, black holes can gradually release energy over extremely long timescales, offering a possibility for the re-emergence of information.

While traditional gravitational theories posit that black holes only absorb matter and light, UFT uses the concept of space divergence to explain black hole evaporation. The production of Hawking radiation can be viewed as spatial divergence manifesting quantum effects near the event horizon, causing black holes to gradually lose mass and eventually evaporate over an extended period. This process indicates that black holes are not eternal entities but can slowly release energy and information.

Under UFT, the black hole information paradox is reinterpreted. As a black hole absorbs matter and information, it transforms this information and energy into a special state of space convergence and gradually releases it through Hawking radiation. Thus, information is not truly lost but is transformed and re-emitted.

The strong gravitational field of a black hole causes significant curvature of the surrounding space, resulting in the gravitational lensing effect where light passing near the black hole is noticeably deflected. In UFT, this bending of light is explained as photons traveling along convergent spatial paths, with spatial convergence causing the photon's path to curve. As photons approach the black hole, they undergo gravitational redshift, losing energy and increasing in wavelength. This phenomenon is interpreted in UFT as the gravitational field influencing the divergence and convergence properties of space.

In the framework of Unified Field Theory, black holes are explained as an extreme state of the gravitational field, where the powerful gravity transitions space from divergence to extreme convergence, resulting in the extreme concentration of matter and information. Black holes not only explain the collapse of matter particles and the formation of spacetime singularities but also provide insights into phenomena such as black hole evaporation, gravitational lensing, and gravitational redshift. From the UFT perspective, black holes represent a unique state of space, showcasing the ultimate interaction between matter and space.

26 Appendix B: Experiments

26.1 Theory

26.1.1 Basic Assumptions

- In the universe, the space around any object always expands outwards in a cylindrical helical motion at the vector speed of light $\vec{c'}$.
- The linear part of the cylindrical helical motion represents the electric field, the rotational part represents the magnetic field, and the acceleration pointing towards the central axis represents the gravitational field.

26.1.2 Nature of Gravitational Field

- The gravitational field is essentially the acceleration of space itself towards the object.

26.1.3 Definition of Magnetic Field

- The magnetic field is the rotational motion of space around a vector velocity $\vec{v}$ as its central axis.
- A moving charged particle induces a change in the perpendicular direction of the electric field, which can be considered as the magnetic field.

$$\vec{B} = \frac{1}{c^2}\vec{v} \times \vec{E}$$

26.1.4 Gravitational Field Produced by a Time-Varying Magnetic Field

- When the magnetic field changes over time, it generates a varying electric field (Faraday's law of electromagnetic induction) and a gravitational field.

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\frac{d\vec{v}}{dt} \times \vec{E} + \frac{1}{c^2}\vec{v} \times \frac{d\vec{E}}{dt}$$

- Faraday's law of electromagnetic induction:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\vec{v} \times \frac{d\vec{E}}{dt}$$

- Time-varying magnetic field generating a gravitational field:

$$\frac{d\vec{B}}{dt} = \frac{1}{c^2}\frac{d\vec{v}}{dt} \times \vec{E}$$

26.1.5 Experimental Verification

- Experiment A: An accelerating positive charge generates a gravitational field in the direction opposite to its acceleration.
- Experiment B: Changing the magnetic field generates a vortex gravitational field, causing objects to rotate.
- Experiment C: Experimental Setup for Vortex Gravitational Field in a Faraday Cage

26.2 Experiment A: Accelerating positively charged particles can generate a linear gravitational field in the opposite direction of acceleration.

Date of the experiment: November 2nd, 2023

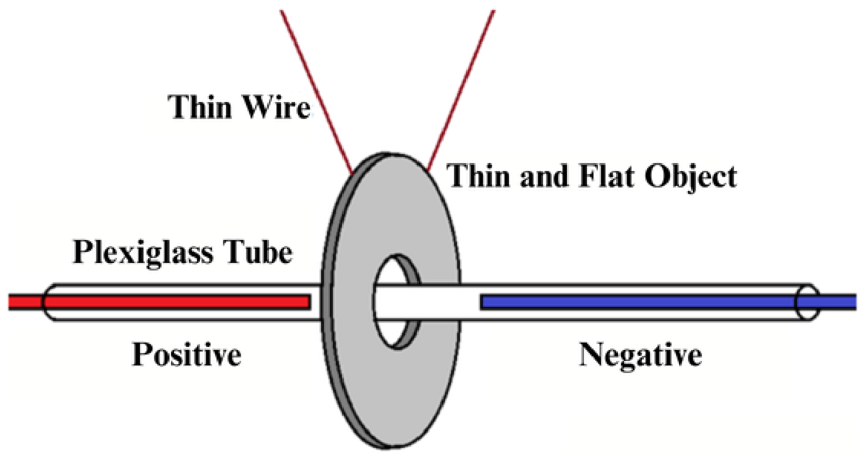


Figure 6: Experiment A

Materials Required

- **High voltage DC power supply** (30kV or above, recommended using 7.4V DC input, 30kV output high voltage package, can be purchased from online stores like Taobao with 2000kV marked high voltage generator)
- **Two enameled copper wires** (90 cm long, 0.8 mm diameter)
- **Silicone/Plexiglass tube** (190 cm long, 3 mm outer diameter, 1 mm inner diameter)
- **Plastic sheet** (4 cm × 11 cm, thickness 0.15 mm, any material)
- **Thin cotton thread** (for hanging the plastic sheet)
- **Wooden frame** (for suspending the entire apparatus)

- **Lubricating oil** (for helping insert the wire into the silicone tube)
- **DC power supply unit** (input: 220V AC, output: 0-30V DC)
- **Vacuum chamber** (optional, if conducting experiments in a vacuum)
- **Flame (candle)** or **high voltage DC meter** (for determining the polarity of the high voltage output)
- **Injection syringe** (for injecting lubricant into the silicone tube)

Experimental Procedure

1. **Assemble the apparatus**:
   - Insert the two enamelled copper wires into the silicone tube, ensuring they do not touch and are separated by 4.5 cm. If the wires are difficult to insert, use lubricating oil.
   - Suspend the silicone tube horizontally from the wooden frame.
   - Hang the plastic sheet using a thin cotton thread. Make a small hole in the center of the plastic sheet and slide it onto the silicone tube without making contact. Ensure it is positioned at the center between the two wires.
2. **Connect the high-voltage power supply**:
   - Connect the ends of the enamelled copper wires to the positive and negative terminals of two high-voltage packages. For better results, power the two packages separately.
   - Use a DC power supply unit or other DC source to power the high-voltage packages. The recommended input is 0-30V DC.
3. **Determine polarity**:
   - To determine the polarity of the high voltage output, use a candle flame: place the two high-voltage output wires 8-10 cm apart, light the candle, and observe the flame's deflection when the power is turned on. The flame will deflect toward the negative terminal.
   - Alternatively, use a high-voltage DC meter to directly measure the polarity.
4. **Conduct the experiment**:
   - Turn on the power and observe the motion of the plastic sheet. Record whether it moves toward the positive terminal.
   - Reverse the polarity of the high-voltage supply and repeat the procedure. Observe whether the plastic sheet still moves toward the positive terminal.
   - Repeat the experiment multiple times to ensure consistent results.

5. **Vacuum experiment (optional)**:

    - Perform the same experiment in a vacuum chamber to eliminate the effects of ion wind and static effects. This step will help validate the results.

Experimental Notes

1. **Preventing ion wind and static effects**:

    - Use a silicone tube or acrylic tube to enclose the wires, preventing ion wind and static motor effects from influencing the experimental results.
    - Ensure that the wire joints are fully insulated to prevent charge leakage that could affect the experiment.

2. **Preventing polarization effects**:

    - The hanging object should be a thin sheet to suppress polarization and depolarization effects. Avoid performing the experiment repeatedly in a short period of time to prevent these effects from causing erratic movement of the plastic sheet.

3. **High voltage safety**:

    - Take precautions when working with high-voltage equipment to avoid electric shock. Ensure all components, including wires, connectors, and the high-voltage package, are properly insulated.
    - High voltage packages with pulsed DC output may introduce noise, which could interfere with the experiment. It is recommended to avoid using multiple high-voltage packages in series or parallel, and instead, use a single DC source above 20kV for better results.

Conclusion

The experiment demonstrates that when a high-voltage DC power supply is connected, the plastic sheet moves towards the positive terminal. This occurs regardless of whether the polarity is reversed, with the object consistently moving towards the positive side. This verifies the hypothesis that accelerated motion of positive charges in the circuit produces a gravitational field, as predicted by Unified Field Theory. Repeating the experiment in a vacuum further eliminates the effects of ion wind and static forces, thereby reinforcing the validity of the results.

26.3 Experiment B: Magnetic field changes can generate a vortex gravity field that causes all objects to rotate.

Date of the experiment: November 2nd, 2023

Figure 7: Experiment B

Materials Required

- **Enameled copper wire** (0.57 mm diameter, enough to wind two coils with many turns)
- **Paper cylinder** (1 mm thick, 3.7 cm diameter, 19 cm long, used as a support for the coils)
- **High voltage package** (input: 7.4V DC, output: high-voltage pulse, available on Taobao with a marked 200kV, actual output around 30kV)

- **DC power supply** (7.4V input to power the high-voltage package)
- **Vacuum chamber** (10 cm in diameter, capable of being evacuated)
- **Red polyethylene ball** (to be suspended inside the vacuum chamber)
- **Thin cotton thread** (for suspending the polyethylene ball)
- **AB glue** (for fixing the cotton thread to the inner wall of the vacuum chamber)
- **Wooden frame** (for suspending the entire apparatus)
- **Vacuum pump** (to evacuate the air from the vacuum chamber)

Experimental Procedure

1. **Assemble the coils**:
   - Wind two helical coils using 0.57 mm enamelled copper wire, each coil being 19 cm long and 3.7 cm in diameter. The coils should be wound on a 1 mm thick paper cylinder, and the number of turns should be sufficient to highlight the rotational effect of the magnetic field.
   - Connect one end of the top coil to the negative terminal of the high-voltage package, and the other end is placed on top of the vacuum chamber.
   - Connect the top of the lower coil to the vacuum chamber, and the bottom to the positive terminal of the high-voltage package. The coils should be 10 cm apart and not connected to each other.
2. **Install the vacuum chamber and suspend the ball**:
   - Use a vacuum pump to evacuate the vacuum chamber, ensuring no air is left inside.
   - Inside the vacuum chamber, use AB glue to fix one end of a thin cotton thread to the inner wall, and suspend the red polyethylene ball on the other end. Ensure the ball is freely suspended and does not touch the chamber walls.
3. **Connect the high-voltage power supply**:
   - Connect the high-voltage package to a 7.4V DC power supply, ensuring it can produce high-voltage pulses.
   - Make sure that the top and bottom coils are connected to the positive and negative terminals of the high-voltage package, completing the circuit.
4. **Conduct the experiment**:
   - Turn on the power to generate a changing magnetic field and observe whether the polyethylene ball inside the vacuum chamber starts to rotate.

- Record the ball's rotation, especially noting if it rotates along the axis of the magnetic field lines.
- Repeat the experiment to ensure consistent results and verify the rotational effect.

5. **Eliminate interference factors**:

   - Conduct the experiment in a vacuum to eliminate ion wind and electrostatic motor effects.
   - Observe the rotation direction of the ball to confirm that polarization effects are minimized.

Experimental Notes

1. **Preventing polarization effects**:

   - The polyethylene ball rotates along the axis of the thread, and the force from polarization effects acts along the thread direction, meaning polarization does not contribute to the rotation.
   - Avoid conducting the experiment repeatedly in a short time frame, as repeated tests can cause severe material polarization, leading to erratic rotation directions.

2. **Minimizing linear gravitational interference**:

   - Use coils with a large number of turns to enhance the rotational effect of the magnetic field while reducing the linear gravitational field generated by the electric field.

3. **High voltage safety**:

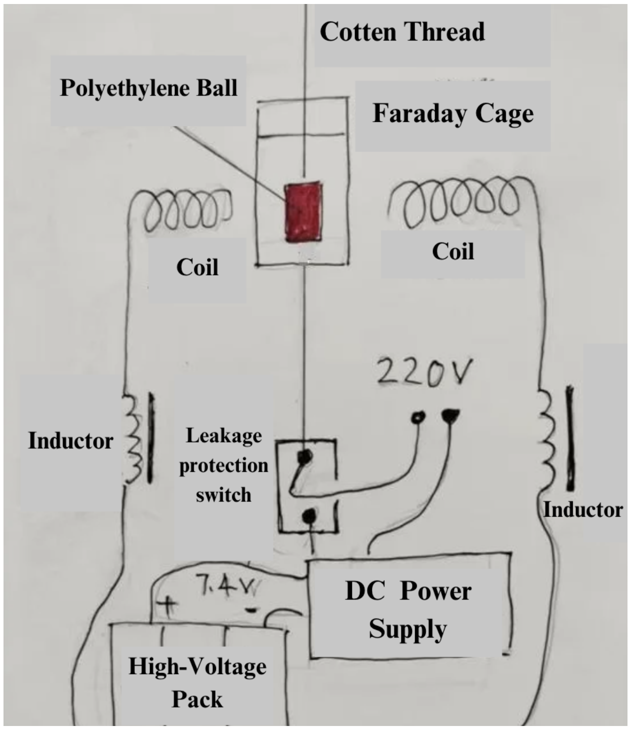
   - The high-voltage package produces a high voltage output, so take proper insulation precautions to avoid the risk of electric shock. Ensure that all connections, wires, and the high-voltage package are properly insulated.

Conclusion

This experiment demonstrates that when high-voltage pulse current is passed through the two coils, the changing magnetic field induces the red polyethylene ball in the vacuum chamber to rotate around the axis of the magnetic field lines. This confirms that the changing magnetic field generates a vortex gravitational field, causing objects to rotate. The experiment successfully eliminates ion wind, electrostatic motor, and polarization effects, verifying the vortex gravitational effect predicted by the Unified Field Theory.

By using coils with many turns, the magnetic field effect is enhanced, and the linear gravitational effect of the electric field is suppressed, making the vortex gravitational effect more prominent and easier to analyze.

26.4 Experiment C: Experimental Setup for Vortex Gravitational Field in a Faraday Cage



(a) Experiment B: Circuit Flow Chart

(b) Experiment B: Setup Extension

Figure 8: Side by side of Experiment B: Extensions

Materials Required

- **Stainless steel Faraday cage** (7 cm diameter, 18 cm height)
- **Red polyethylene ball** (2.7 cm diameter, 5 cm height)
- **Thin cotton thread** (for suspending the polyethylene ball)
- **Enameled copper wire** (0.57 mm diameter, enough to wind two coils, each 19 cm long, 3.7 cm diameter)
- **Paper tube** (1 mm thick, used as support for the coils)
- **High voltage package** (input: 7.4V DC, output: high-voltage pulses, available online with a 2000kV marking)
- **DC power supply unit** (to power the high-voltage package)

- **Plastic tube** (0.6 cm diameter, 21 cm height)
- **Sleeve** (to insert the plastic tube and keep the Faraday cage upright)
- **AB glue** (for fixing the cotton thread and plastic tube)
- **Leakage protection switch** (to control the opening of the Faraday cage)
- **Silicon steel core coil** (optional, used to increase inductance energy)

Experimental Procedure

1. **Assemble the Faraday cage and coil system**:
   - Place the stainless steel Faraday cage in the experimental setup, with the bottom of the cage glued to a plastic tube using AB glue. The plastic tube should be inserted into a sleeve to keep the Faraday cage upright and stable.
   - Suspend the red polyethylene ball inside the Faraday cage using thin cotton thread. The other end of the thread should be fixed to the top of the Faraday cage to ensure the ball is freely hanging and not touching the cage walls.
2. **Connect the coils and the electrical circuit**:
   - Wind two helical coils using 0.57 mm enameled copper wire, each 19 cm long and 3.7 cm in diameter. The coils should be wound on a 1 mm thick paper tube with enough turns to enhance the magnetic field effect.
   - Connect the two coils to the high voltage package. One coil should be connected to the positive terminal, and the other to the negative terminal of the high voltage package.
   - Connect the DC power supply to the high voltage package, providing a 7.4V DC input to activate the high voltage pulses.
3. **Set up the leakage protection switch**:
   - Attach a leakage protection switch at the bottom of the stainless steel Faraday cage, with one end of the cotton thread fixed to the switch. When the switch is pulled down, it should open the bottom part of the Faraday cage, causing it to fall and expose the suspended polyethylene ball.
4. **Conduct the experiment**:
   - Turn on the DC power supply to activate the high voltage package and generate high voltage pulses through the coils. During this time, observe that the polyethylene ball inside the Faraday cage remains stationary.
   - Pull the leakage protection switch to cut off the power. The cotton thread will open the bottom part of the Faraday cage, causing the lower part of the cage to fall and expose the red polyethylene ball.

- Observe whether the polyethylene ball starts to rotate after the power is cut off, and record the time and speed of the rotation.

5. **Increase inductance energy** (optional):

    - In later experiments, connect the output terminals of the high voltage package to a silicon steel core coil to increase the inductance energy.
    - Observe whether the rotation duration of the polyethylene ball increases, and record the corresponding results.

Experimental Notes

1. **Eliminate interference effects**:

    - Since the experiment is conducted after the power is cut off, and the polyethylene ball is initially stationary inside the Faraday cage, it rules out polarization effects, electrostatic motor effects, and ion wind effects, which occur only during powered conditions.
    - The polyethylene ball inside the Faraday cage does not experience magnetic field effects or polarization effects, as the Faraday cage effectively shields the electric and gravitational fields.

2. **Avoid repeated experiments**:

    - Avoid conducting the experiment repeatedly within a short time frame to prevent material polarization, which could cause instability in the experimental results.

3. **High voltage safety**:

    - Ensure proper insulation of the high voltage package and the electrical components to avoid the risk of electric shock during the experiment.

Conclusion

During the experiment, when the circuit is powered, the red polyethylene ball inside the Faraday cage remains stationary, indicating that the Faraday cage effectively shields both the electric and gravitational fields. When the leakage protection switch is activated, the power is cut off, and the bottom part of the Faraday cage falls, exposing the polyethylene ball. Despite the power being off, the polyethylene ball begins to rotate.

This phenomenon verifies the theory from Unified Field Theory that a changing electromagnetic field generates a vortex gravitational field. Even in the absence of power, the inductance energy stored in the coils is released via the vortex gravitational field, causing the polyethylene ball to rotate. By increasing the inductance energy, the duration of the ball's rotation can be extended, further demonstrating the relationship between inductance energy and vortex gravitational effects.

The experiment successfully eliminates interference from polarization, electrostatic motor, and ion wind effects, providing a clear and simple setup to analyze the vortex gravitational field produced by changing magnetic fields.

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