Online ISSN : 2249-4626
Print ISSN : 0975-5896
DOI : 10.17406/GJSFR

Global Journal

of Science Frontier Research: A

Physics and Space Science

Mass Interaction Principle

Fractal Quantum Gravity Theory

Highlights

Origins of Universal Expansion

Single Instruction Quantum Computer

Discovering Thoughts, Inventing Future

VOLUME 24 ISSUE 3 VERSION 1.0

Global Journal of Science Frontier Research: A
Physics & Space Science

Global Journal of Science Frontier Research: A
Physics & Space Science

Volume 24 Issue 3 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals® Headquarters
945th Concord Streets,
Framingham Massachusetts Pin: 01701,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals Pvt Ltd
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Excluding Air Parcel Charges):

Yearly Subscription (Personal & Institutional)
250 USD (B/W) & 350 USD (Color)

Editorial Board

Global Journal of Science Frontier Research

Contents of the Issue

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 24 Issue 3 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed Interenational Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Unveiling Gravity: Exploring the Origins of Universal Expansion

By Dr. Bernal Thalman

University of Costa Rica

Abstract- From fluid dynamics, we conceptualize gravitational waves as inviscid shock waves within a zero-viscosity medium, where space-time acts as a fluid devoid of mass. This fluidic perspective elucidates gravitational wave phenomena and offers insights into quantum entanglement.

Our paper uses a mathematical model called the Minkowski equation to describe space-time. This equation combines space and time into a single framework, as proposed by the theory of relativity.

Keywords: gravitation, astrophysics, cosmology, space-time, cosmos expansion, gravity, dark energy, nozzle effect, relativity, quantum gravity.

GJSFR-A Classification: LCC: QB981-QB991

UNVEILINGGRAVITYEXPLORINGTHEORIGINSOFUNIVERSALEXPANSION

Strictly as per the compliance and regulations of:

"Unveiling Gravity: Exploring the Origins of Universal Expansion"

Dr. Bernal Thalman

Abstract- From fluid dynamics, we conceptualize gravitational waves as inviscid shock waves within a zero-viscosity medium, where space-time acts as a fluid devoid of mass. This fluidic perspective elucidates gravitational wave phenomena and offers insights into quantum entanglement.

Our paper uses a mathematical model called the Minkowski equation to describe space-time. This equation combines space and time into a single framework, as proposed by the theory of relativity.

Through theoretical analysis, we aim to understand the dynamic nature of space-time and how it interacts with gravity. Our research provides new information about how gravity functions.

Weight results from inertia pushing upward rather than being attributed to the pull of gravity.

We build upon Einstein's theory of relativity, which explains that objects in free fall are at rest. Therefore, gravitation does not cause it to accelerate and always has zero acceleration. In free fall, the acceleration is by coordinates. The object will experience coordinate's acceleration but no acceleration of its own and thus no "g" force.

There is no force of attraction, and the object in free fall does not accelerate. It is approaching the Earth's coordinates at an increasing rate, making an apparent Earth expansion. Earth coordinates are space-time flow.

Our theory defines the universal expansion of space-time as occurring everywhere, including the quantum level. When this expansion happens inside the atoms, it produces a space-time flow by a nozzle effect; this space-time flow is gravity. The general expansion inside matter creates gravity, and outside matter counteracts it.

Our approach to explaining this Gravity theory is observing its space-time behavior.

Our theory states that expansion is the beginning of time and occurs at present, starting all over above the Planck length space-time.

Although we have no mass in space-time, its behavior, similar to that of a fluid, allows us to speak of the nozzle velocity and pressure of space-time and its accelerated flow. We secure this concept because space-time's accelerated frame is the inertia that produces force when the matter is present.

The acceleration of gravity is caused by the expansion of space-time within atoms. This expansion resembles the rapid flow from a nozzle or jet. As the space-time flow accelerates, it gradually exerts pressures that propel it towards the outer limits of matter. This process expels the excess space-time from within matter due to expansion, resulting in a flow.

Weight gravity is the inertia due to the acceleration of space-time flux produced by space-time inside atoms nozzle effect.

Keywords: gravitation, astrophysics, cosmology, space-time, cosmos expansion, gravity, dark energy, nozzle effect, relativity, quantum gravity.

Author: Faculty of Engineering University of Costa Rica San.
e-mail: bernal.thalman@gmail.com

I. Introduction

This manuscript introduces a theory of gravity, shedding new light on its relationship with space-time. We base our study on the mathematical representation provided by the Minkowski equation, which unifies space and time according to the principles of the theory of relativity.

The theory, which extends from Einstein's principles, offers an intriguing reinterpretation of gravitational phenomena. By positing that the apparent broadening of the Earth is a result of the Earth's surface seemingly accelerating towards objects, propelled by a flow of space-time emerging from the Earth, we offer a novel perspective on the nature of gravity. In this framework, gravity is reimagined as a consequence of space-time dynamics, wherein the curvature and flow of space-time influence the motion of objects.

Our theory can contribute to the ongoing exploration and refinement of our understanding of gravity and the fundamental forces of nature.

We focus on space-time expansion above the Planck scale, proposing that a distinct pressure drives this expansion and not conventional mass-related energy. Our theory extends from the microscopic to the cosmological scale, offering valuable perspectives on combining gravity with quantum physics. Our investigation focuses on the concept of space-time expansion above the Planck scale. Incorporating from the microscopic to the cosmological, it unites quantum mechanics with gravity and simplifies the understanding of the fundamental phenomena of the universe.

The weight we feel results from inertia. Contrary to popular belief, weigh-in gravity is not an attraction but a push.

From fluid dynamics, we conceptualize gravitational waves as inviscid shock waves within a zero-viscosity medium, where space-time acts as a fluid devoid of mass.

However, it's important to note that dark energy doesn't correspond to the energy related to mass, as we commonly understand it in physics. It's a different energy source in space-time. The expansion is not

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

driven by conventional mass-related energy but by distinct energy inherent in the universe's structure.

In Einstein's theory of relativity, objects in free fall undergo the absence of gravitational forces.

The gravitational acceleration results from the accelerated space-time flow rather than an external force acting on matter.

Space-time expansion within atoms gives rise to a nozzle effect akin to the flow from a jet.

Universal expansion occurs at all scales, including the quantum level, and space-time behaves as a fluid medium characterized by acceleration gradients. This accelerated space-time flow generated within atoms by the nozzle effect is the gravitational acceleration experienced by objects, highlighting the inseparable link between space-time dynamics and gravitational forces.

This article explores how inertia, free fall, relativity theory, and other phenomena support this assertion. We are based on Einstein's principle of equivalence: Inertia and weight are identical.

Drawing inspiration from Einstein's principle of equivalence, we elucidate the intrinsic connection between inertia and weight, further solidifying our theory within the framework of relativity.

Our gravity theory continues Einstein's relativistic view, propelling scientific inquiry into new frontiers.

By viewing gravity through the lens of space-time expansion and fluid dynamics, we aim to redefine our understanding of gravitational forces.

II. Description

a) *The Nozzle Effect*

Our Universe expansion produces Gravity, which is an accelerated space-time flow.

However, it is essential to clarify that while specific theories propose space-time having properties analogous to fluids in some contexts, the terminology and particular concepts can vary widely depending on the theory being discussed.

Our unique perspective posits that space-time is not just a fluid but an inviscid fluid. This fluid, devoid of viscosity, is known as a superfluid. Superfluid vacuum theory (SVT) is a theoretical physics and quantum mechanics approach that considers the physical vacuum as a superfluid. [01]

The universe, composed of space-time (formerly known as Ether), undergoes expansion in Space-Time. However, this expansion does not involve matter. This understanding aligns with general affirmations, as evidenced by the following references:

"Hubble's law aligns with the general expansion of space between galaxies or galactic clusters and is not specific to the galaxies or clusters themselves. This clarifies that galaxies remain unchanged; instead, it is the regions between them that expand over time (Kolecki, 2003) [02]."

"Both regular matter, dark matter, and radiation decrease in density as the Universe expands due to its increasing volume. However, dark energy and field energy, present during inflation, represent forms of energy inherent to space itself, as new space is continually created in the expanding Universe (Siegel, 2023) [03]."

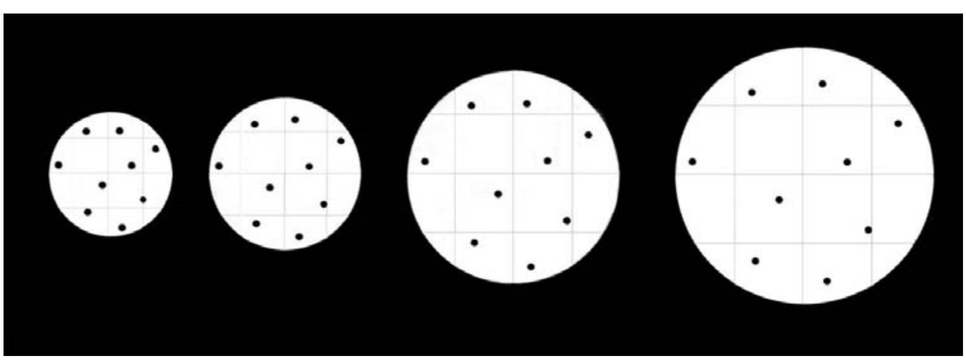


Figure 2.1: The Universe expands, and matter dilutes

Space-time is present both inside and outside matter. Matter is filled with space-time, which permanently expands.

1909, E. Rutherford experimented by launching alpha particles, or helium nuclei, at a thin sheet of gold. To his surprise, most particles passed through the sheet without resistance, while some bounced back. From this, Rutherford concluded that gold atoms must have much empty "space-time" since only a few particles were reflected.

Rutherford's discovery revealed that a minority of particles rebounded after colliding with the nucleus. This breakthrough unveiled the structure of atoms, demonstrating their composition: a dense, positively

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

charged nucleus enveloped by electrons, interspersed with vast interstitial spaces. It is crucial to emphasize that while gold was utilized in the experiment, its selection was not due to uniqueness but rather practicality.

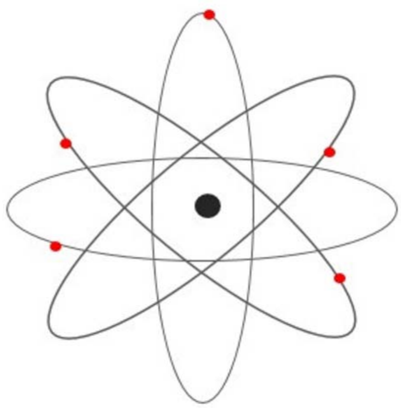


Figure 2.2: Rutherford atom

In quantum mechanics, electrons do not have specific locations like planets orbiting the nucleus of an atom in a classical sense. Instead, their behavior is described by probability distributions known as orbitals. These orbitals represent regions where an electron is likely to be found with a certain probability. The concept of a fixed distance from the nucleus for electrons is a simplified model typically used to introduce atomic structure. However, it only captures part of the complexity of electron behavior.

In the context of atoms and standard quantum mechanics, the idea of virtual particles filling the space-time within atoms is not commonly used or necessary for describing atomic behavior.

Virtual particles are primarily a concept arising from quantum field theory, a more advanced framework than standard quantum mechanics. In quantum field theory, virtual particles arise as mathematical entities that describe interactions between particles within the quantum fields that permeate all of space.[04]. (Virtual particle, 2024. Wikipedia).

However, in describing atoms within standard quantum mechanics, the focus is primarily on the behavior of electrons within orbitals around the nucleus, characterized by wave functions and probability distributions. The concept of virtual particles filling the space-time within atoms is not typically employed in this context because the behavior of electrons in atoms is adequately described without invoking virtual particles.

So, while virtual particles are a significant concept in certain areas of quantum physics, they are not typically considered within the framework of standard atomic theory.

The atom consists of a nucleus surrounded by an electron cloud forming its shell. While the nucleus is small and dense, containing protons and neutrons, the shell is significantly larger. Despite occupying a tiny fraction of the atom's total volume, the nucleus contributes almost all its mass. Thus, atoms primarily comprise space or space-time, rendering matter mostly empty. The barriers to the free expansion of space-time are the nuclei of atoms and the energy contained within the electron cloud.

The space-time within matter evades the pressure of expansion by transforming into a perpetually accelerating flow of space-time, referred to in this article as the 'nozzle effect' phenomenon.

Nozzles are essential tools used in various fields, including gardening and aviation. Like how an airplane engine generates thrust for optimal performance, a garden hose nozzle helps to facilitate efficient water flow. Gravity plays a crucial role in this process, resulting from the accelerated flow of space-time out of mass.

When the acceleration of space-time flow encounters mass, it results in the manifestation of gravity.

In the first article, we introduced the phenomenon of gravity, which may appear to be the expansion of matter. However, in reality, it is the result of accelerated space-time flux. It is important to note that this perspective remains consistent depending on the frame of reference from which it is observed.

Hence, in classical Newtonian physics, the higher the density of matter, the greater the gravitational attraction.

The acceleration of the space-time flow increases radially in proportion to the number of atoms of the matter, its acceleration greater on the surface of massive objects.

b) Space-Time Minkowski Representation

Minkowski represented space-time with a mathematical construct that unifies space and time into a single, continuous entity spanning four dimensions.

In Minkowski's space, three ordinary spatial dimensions and an additional temporal dimension can be distinguished, forming a 4-variety that thus represents space-time.

We base our theory on the Minkowski equation. In mathematical physics, Minkowski space-time is a four-dimensional, zero-curvature Lorentzian manifold used to describe physical phenomena in the framework of Einstein's particular theory of relativity. The model was developed by the German mathematician Hermann Minkowski.

The Minkowski equation represents our four dimensions. It is a representation of our space-time, which is given below.

$$\Delta s^2 = \Delta x^2 + \Delta y^2 + \Delta z^2 - (\Delta t \cdot C)^2$$

Space-Time Representation in the Minkowski Equation

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

The equation is known as the Minkowski equation or the space-time interval. It represents the space-time separation between two events in special relativity, whereΔs is the space -time interval, Δx, Δy, and Δz are the differences in spatial coordinates, Δt is the difference in time coordinates, and C is the speed of light in vacuum.

The equation explains that the space-time interval remains constant regardless of whether an observer is at rest or in motion. Under the law of space-time, the equation called invariance is a fundamental concept in special relativity.

Special Relativity posits that the laws of physics are the same for all inertial observers (observers moving at constant velocity relative to each other), and this principle of invariance underlies many of the theory's predictions and explanations.

Usually, people talk about living in three dimensions plus time. However, Minkowski, Einstein's professor of mathematics, taught us that time is associated with the speed of light to incorporate it as a fourth dimension that is also measurable in meters.

$$(t\cdot C)$$

Let us break down the Minkowski equation by simplifying it to a single spatial dimension and its implications for the representation of space-time:

By considering only one spatial dimension, we can simplify this equation to:

$$\text{Space-time} = x - (t\cdot C)$$

The equation represents a simplified version of the one-dimensional Minkowski equation, emphasizing the relationship between spatial and temporal dimensions in space-time representation.

Minkowski's space-time simplified representation has two axes—the x-axis representing the spatial dimensions x, y, and z, and the (t·C) axis representing the time-light-speed dimension. The unit of (t·C) is the same as that of "x" (meters). "C" represents the speed of light, which has a unit of meters per second. Therefore, "(tC)" is a dimension in meters, just like Euclidean x, y, and z.

Simplification is beneficial when considering gravitational effects, which often exhibit radial symmetry in the universe.

The gravitational field can be described effectively using a single radial vector originating from the center of mass, and spherical coordinates instead of Cartesian coordinates are often convenient.

The (t·C) dimension already incorporates the Euclidean dimensions. Thus, our three familiar dimensions are inherently embedded within the dimension of 'time-speed-of-light.' It effectively conveys that the combination of time and the speed of light already encompasses the three spatial dimensions of Euclidean space.

The dimension is represented by the product of time and the speed of light. It suggests that the dimensions of space and time are intimately interconnected when considering space-time, with the familiar spatial dimensions being a subset or a part of the larger space-time framework.

The (t·C) dimension in the Minkowski equation shows us how time is connected to spatial dimensions, creating a unified framework that explains light's constant speed and motion's relativity.

C (the speed of light) is radial in all directions; the boundary of our universe also expands radially at the speed of light.

Analyzing the Minkowski equation and incorporating our theory, we see that time begins simultaneously throughout our universe and expands radially from all points where there is space-time. The expansion is at the speed of light and according to the trajectory indicated by the different accelerations of space-time.

As we explain this in the subsequent sections. Remember length contraction.

c) *Distinction between Time and the Time-Speed-of-Light Dimension*

Time is one thing, while the "Time-speed-of-light" dimension (t·C) is another. However, there is an intrinsic relationship between them:

There is a distinction between regular time and the "Time-speed-of-light," our fourth dimension. Regular time refers to the familiar passage of time we experience daily. In contrast, the "Time-speed-of-light" dimension, represented by the product (t·C), is a construct in physics that combines time with the speed of light. This dimension arises in Special Relativity, where space and time are unified into space-time, and the speed of light plays a fundamental role.

Despite the distinction, a fundamental connection or relationship exists between regular time and the 'Time-speed-of-light' dimension. They are inherently linked in the framework of physics. In Special Relativity, the speed of light is a fundamental constant that influences space and time, leading to phenomena such as time dilation, length contraction, and "the dimension where the universal expansion occurs."[05] (Thalman, B. (2024).

The expansion of space-time appears to occur only in the time-speed-of-light dimension (t·C), pointing out that the (t·C) dimension already incorporates the Euclidean dimensions, our usual three dimensions through the speed of light.

The statement is made within the context of the Minkowski concept, which deals with the mathematical framework of space-time in Special Relativity.

(t·C) already encompasses the familiar three spatial dimensions (length, width, height) through the speed of light. This means that the effects of the speed of light extend beyond just time, influencing all spatial dimensions.

"It can be concluded that the universe's expansion only occurs in the 'time-speed-of-light' dimension.

Understanding the dynamics of the universe's expansion within the framework of Special Relativity emphasizes the importance of the speed of light. Thus, from its frame of reference, an object, along with the space-time it experiences in its trajectory, can be viewed as a system with a flat Minkowski metric.

It's essential to recognize that time isn't a tangible entity,but the time-speed-of-light dimension is fundamental to our universe. Events unfold at various points in this dimension, and our concept of time measures and sequences them. Time extends continuously, allowing us to discern and chronicle its occurrences. In other words, events can be framed.

However, it's important to clarify that while space-time is regarded as a dimension within the mathematical framework of special relativity, it differs from our conventional understanding of time. Time is subjectively experienced as a unidirectional flow, whereas the spatial dimension of space-time permits movement in multiple directions. It constitutes a fundamental aspect of the universal expansion encompassed by the concept of 'time-speed-of-light.'

The Minkowski equation suggests that time behaves as a dimension that expands at the speed of light, a significant concept in physics. This equation reveals a fundamental connection between time and the speed of light within the space-time framework. By representing time as a dimension combined with the speed of light, the Minkowski equation offers insights into why velocity can be undetermined in specific contexts. This understanding extends beyond phenomena like time dilation and length contraction to encompass the nature of velocity in gravitational phenomena.

d) Gravity viewpoint and perspectives

The gravity experience is subjective and contingent upon perspective. Your understanding of this, along with the first postulate of the theory of relativity, which asserts the uniformity of physics across all inertial frames of reference, is crucial and integral to our discussion.

Einstein's equivalence principle establishes the equivalence between gravitational and inertial mass. This principle is fundamental to our understanding of gravity. It implies that the effects of gravity experienced by an object are identical to those of acceleration in a non-gravitational setting.

We assert that weight arises from the inertia imparted by the acceleration of the space-time flow, a concept that demands careful consideration.

The perturbation caused by matter in space-time inside atoms produces a radially accelerated flow of space-time that causes the acceleration of the massive object during the fall and the upward push of the object (the weight) if it is on the surface.

To understand why we experience a downward pull, we consider that the Earth exerts an upward push on us and over all objects on its surface at a rate of 9.8 m/s^2.

When we are in free fall from above the Earth's surface, the Earth appears to be rapidly approaching us. Our first publication [06] (Thalman, B. 2023) explains this issue of apparent perception in detail.

Upon analyzing our planetary system, we have observed that despite the perceived acceleration of expansion, the Earth and other elements do not increase in size. This discrepancy is reconciled by understanding that space with its coordinates moves towards us when we are in free fall and do not experience any force. Space movement towards us is described by space-time flux, which plays a crucial role in our perception of objects in motion.

Have you ever experienced the relative velocity effect while standing at a train station? When a train next to us moves, we feel like our train is moving, too, in the opposite direction.

Similarly, when we stand in front of a moving object and start moving forward with it, it feels as if the object's space-time is coming towards us while we remain stationary.

Relativity is the same as saying, I go to space, as space comes to me. (Earth comes to you; it is the same as you fall to Earth).

What is happening is that the flux of space-time is coming out of the Earth, causing a fall towards it. In classic physics, you are falling towards the Earth, which remains the same size and does not expand.

Nevertheless, the inbound flux of space-time passing through you creates the perception that the Earth is approaching. When you're on the Earth's surface, your weight stems from the inertia of the space-time flux's acceleration, which makes the surface propel you upward.

This study posits an alternative investigation of gravity as an accelerated space-time flow out of the interior of massive objects (e.g., the Earth), causing the reference coordinates to move upward and creating the illusion of falling toward the Earth.

The Earth's expansion is apparent and creates the illusion of an expanding Earth; the space-time flow emanating from Earth generates gravity.

We perceive a force pushing us upward when we stand on Earth's surface. This sensation results from the acceleration of space-time flow radiating outward from Earth at approximately 9.8 meters per second squared, giving rise to an apparent expansion of the Earth's surface.

Dark energy permeates the fabric of the universe, driving its accelerated expansion. Cosmic inflation, a key concept, illustrates the continuous widening of space-time.

The expansion of space-time within atoms accelerates space-time flow, akin to a nozzle effect, as it seeks release from matter. Gravity emerges from this accelerated space-time flow.

The enigmatic dark energy permeates the cosmos with its omnipresence, discovered in 1998. It represents a non-analytical energy that manifests as a fundamental property of space-time. This property, inherent to every point in the universe, propels an expansive push, shaping the fabric of space-time itself.

Dark energy is a mysterious energy that exists all around the universe. It was first discovered in 1998 and cannot be easily analyzed. Instead, it is a fundamental property of space-time. This property exists in every point of the universe, and it causes space-time to expand.

e) The Space-Time Curvature

Many people assert that Einstein's theory of relativity explains that the presence of mass causes gravity by curving space-time. This statement is correct, but space-time curvature can be simplified for curious people.

We must be very clear that the atomic nozzle produces the space-time flow.

In atoms, there is muchspace-time between the nucleus and the electrons, which we have called the inter-nucleus-electrons space.

Space-time within matter expands, producing a nozzle effect. It becomes an accelerated jet that comes out, so to speak, through the "pores" of the matter at the quantum level. On Earth's surface, it comes out at 9.8 m/s².

Acceleration is a term used to describe a change in velocity. When an object falls towards the ground, it picks up speed at an increasing rate. If the object is on Earth's surface, it experiences an upward force equal to its mass multiplied by the acceleration of space-time flux coming outward from Earth.

In particular, the speed of the space-time flow remains indeterminate, similar to the speed of any object concerning the speed of light. This concept will be clarified in the next section.

The inherent inertia of space-time becomes evident. This inertia, related to space-time flow acceleration, ensures that space-time maintains its march through time without velocity limitations inside the speed of light despite classical mathematical and physical worldviews.

Once the space-time flow from massive objects leaves out of matter, such as the Earth, it follows a hyperbolic decrease with the square of the radius, shaping concentric spheres characterized by identical flow acceleration.

The acceleration is less and less and always the same for every object of matter, depending on heights or radial distances from the center of mass. Remember the lack of a definite value concerning velocity.

The acceleration is present without change at the same distance from the center of mass, but as we explain later in the next chapter, there is no definite value concerning the velocity of the space-time flow.

Einstein realized that there was no way this man could tell whether he was sitting in a gravitational field or being accelerated. Because of this, these two situations were equal. By extension, Einstein concluded that gravity and acceleration are the same thing.[07]Gravity and acceleration are the same thing.

Einstein's ground-breaking realization (which he called "the happiest thought of my life") was that gravity is, in reality, not a force at all but is indistinguishable from and, in fact, the same thing as acceleration.[08] Physics of the Universe.

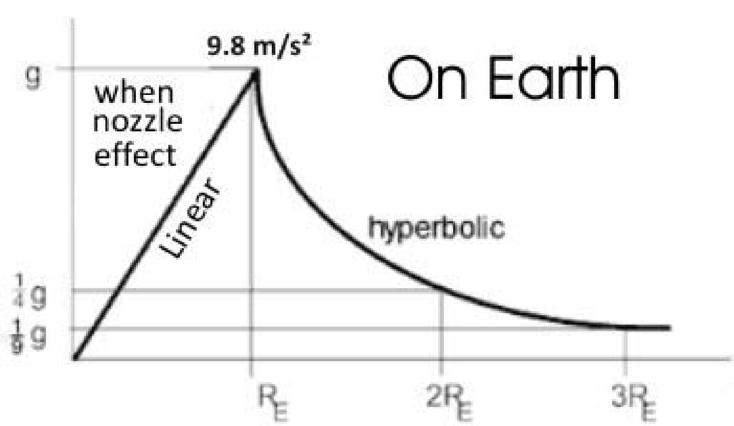


Figure 2.3: The 9.8 m/s² acceleration decreases rapidly as we move up away

R = radius of the earth = 6,371 km.

The intensity decreases because it is distributed over the surface of the concentric spheres. The larger the radius of the concentric sphere, the larger its surface area and acceleration smaller.

In simpler terms, the intensity of the space-time acceleration (gravitational field) at any point of these concentric spheres, when this intensity is multiplied by the surface of the corresponding sphere, remains constant. The same value is in all these spheres.

This phenomenon is the same as the behavior of the luminous intensity realized by a source emitting radial radiation, following the inverse square law.

The inverse square law states that the intensity of radiation or light is inversely proportional to the square of the distance from the source.

An asymptotic hyperbola represents the gravitational potential energy.

The apparent gravitational force of attraction due to a mass is radial and dependent only on the distance to the center.

The curvature of space-time is the curvature that Einstein talks about in his general theory. It is a spherical envelope.

Space-time flows (Gravity) radially outward from spherical bodies, forming equidistant spherical surfaces around massive objects with equal acceleration.

The space-time curvature (gravitational equipotential surfaces).

Visualizing the distribution of the gravitational potential field in space is possible with equipotential surfaces.

In gravitational physics, it's often observed that the surface of massive objects tends to approximate a sphere. This spherical shape ensures that each point on the object's surface experiences the same gravitational acceleration. As you move away from the object's center above the surface radially, the gravitational acceleration decreases on concentric spheres. These spheres, characterized by uniform gravitational acceleration, play a crucial role in the curvature of space-time around the massive object.

This curvature of space-time, combined with the translational kinetic energy of the stellar bodies, produces the geodesics we observe as elliptical trajectories.

We can ensure straight paths by converting a reference frame to curved trajectories. (My subsequent publication).

Our theory proposes generalizing the Minkowski metric in special relativity to account for astronomical motions within flat space-time. Despite the appearance of elliptical paths, these motions follow geodesic trajectories that are straight and constant at a specific velocity.

The system can be presented with a flat Minkowski metric depending on the reference chosen.

f) The undetermined speed of the space-time flow

Light always travels or moves at a constant speed of 300,000 kilometers per second, regardless of where or how we observe it, irrespective of the observer's location or perspective.

The speed of light is a constant that remains unaffected by the motion of its source, even if we observe light from a moving object. No matter how fast or slow the object we are in moves, the speed of light remains unchanged, one of the characteristics of the nature of light's behavior.

Just as light maintains its velocity independently of our perspective, the velocity of the space-time flow, regardless or independent of any acceleration, the velocity of space-time remains indeterminate.

We can return here to Minkowski's space-time representation, where the time-speed-of-light dimension shows us the complex interplay of space-time motion: $(t \cdot C)$

$$\text{Space-time} = x - (t \cdot C)$$

Otherwise, the speed of space-time flow would reach the speed of light quickly, but when the space-time flow moves in time, it does not physically move in space. However, it continues to move at the speed of light through time. Minkowski space is a concept that combines inertial space and time manifolds with a non-inertial reference frame of space and time.

Some definitions of the relationship between light, space-time, and acceleration can make the following description comprehensive:

"*Inertia built into the space-time flow*"

Inertia in the fourth dimension is what we call Virtual Inertia. In Classical physics, we relate energy and inertia with a mass; we call virtual inertia the inertia without related mass.

Also, energy without related mass is called virtual or dark energy.

The concept of inertia refers to the tendency of objects to resist changes in their motion. In other words, the distribution of mass and energy in the universe determines the shape of space-time and how objects move through it. Even relativistically, the universe expands geodesically. The intrinsic link between them shows the connection between space-time and inertia. The energy in space-time changes its acceleration according to inertia. Let's see virtual inertia from space-time as the main frame: The acceleration shape of space-time flux is Gravity manifests itself by the Inertia: $F = m \cdot g$.

The acceleration of space-time flow radially outward from Earth is a 'virtual inertia,' which is 9.8 m/sec2 at the surface of the Earth and is the same force that pushes you upward on the Earth's surface. It is caused by the apparent broadening of matter, a relativistic equivalent of space-time flow.

The effect we have called the nozzle produces a jet of accelerated space-time flow that is a virtual inertia, which, when it encounters matter, makes a real inertia on its mass.

Pushing space-time outside of Earth (Earth does not expand, looks like it) is this space-time flux that makes Earth coordinates move upward to make the falling into Earth. As we saw in the representation of space-time, according to Minkowski, its component is $(-t\cdot C)$. B. Thalman DOI: 10.4236/ojpp.2024.141016 208 Open Journal of Philosophy The inertia we feel due to the accelerated space-time flow causes our weight. This virtual inertia (no mass involved) does not affect the Cartesian spatial dimensions. Then, its shape is accelerated so that when it passes through objects with mass, it causes a force (what we call inertia). $F = m\cdot a$

The present moment (Real-time) is created continuously at the start of a new time.

The acceleration we experience on the surface of the Earth is a result of the inertia built into the space-time flow. This inertia causes the associated velocity (ds/dt) to be immersed in the appearance of time. The time base of the acceleration (d^2s/dt^2) is the same as that of the present, marking the beginning of time in the primary expansion.

The derivative of the velocity with time is the acceleration ($a = dv/dt$). The only thing within our reach is the inertia that produces the phenomenon from the space-time behavior in its expansion, which is internal in matter, the nozzle effect that incorporates the shape that represents the virtual inertia that becomes real when encountering mass, the process that deforms the space-time, turning it into a flow.

Like light, space-time has no mass, and its movement has unique characteristics. Space-time flux moves at the speed of light through time; the speed of light is the same for all observers, regardless of their relative motion; while the acceleration of space-time is determined, its velocity is not established.

In essence, space-time, like light, lacks mass and exhibits distinct movement patterns. While its acceleration can be measured, its velocity remains undefined.

g) Free-Fall

Unlike classical mechanics, Einstein's first law reframed our understanding of gravity. It no longer viewed gravity as a force. This means that objects in free fall are genuinely free—as traditionally understood, no force acts upon them. It's a common misconception that schools and universities perpetuate, teaching that the weight and velocity increase in a fall is due to a gravitational force. While the calculations are accurate, the interpretation of the phenomenon is incorrect.

This section on free-fall delves into the concept within the framework of Einstein's theory of relativity.[09] Einstein, A. (2001). Relativity.

However, because our gravity theory is an extension of Einstein's relativistic view, applying Einstein's theory of relativity to the following examples of throwing a ball upward adds depth to the discussion, such as the Earth's apparent widening due to space-time expansion.

Let's delve into the basic concepts of the theory of relativity in low-velocity motions far from the speed of light (known as C). To illustrate this, we'll use throwing a ball upward. First, we'll analyze it using classical physics principles. Then, we'll apply the general theory of relativity and our extension of Einstein's relativistic view. The ball's motion can be understood as two uniformly accelerated movements: upward and downward. During the vertical launch, the ball will reach its maximum height point with zero velocity.

Figure 2.4: Vertical throwing of a ball

The ball in all its path is momentarily suspended, just before starting the descent, permanently in free fall. The ball launched upward to a certain height requires a specific initial velocity also determined. It will leave behind the initial launch point in its free fall and continue its downward trajectory. When the object passes through the launch (Figure 1) point, its velocity will take the same value as when the ball was launched but in the opposite direction. In this motion, the acceleration, consistently downward, is the gravitational acceleration approximately (9.8 m/s^2).

According to our theory, the apparent broadening of the Earth is attributed to the apparent acceleration of the Earth's surface towards the ball. This acceleration is posited to be caused by a flow of space-time emerging from the Earth. In this framework, gravity is conceptualized as a consequence of this space-time flow, which influences the motion of objects by causing the Earth's surface to accelerate towards them seemingly. It's important to note that our theory presents an alternative extended from Einstein's theories of relativity.

Our theory is based on Einstein's principles. Of course, It would need to undergo rigorous testing and evaluation to assess its validity and explanatory power compared to existing models.

The ball follows a trajectory previously determined according to its initial kinetic energy and by space-time accelerated flux.

Before throwing the ball, you can feel the acceleration weight pushing you and the ball up. You give the ball an initial upward velocity, added to the acceleration by the Earth's apparent widening caused by the space-time flowgoing outward from the Earth's surface.

Space-time moves upward faster and faster, and as you stand on the surface of the Earth, it pushes you upward.

When the ball is in the air, it is at rest and only observes what is happening around it: There is only one uniformly accelerated motion, not two separate motions.

While the ball is in free fall, the Earth's surface approaches accelerated due to its apparent displacement. However, it is the space-time fluid that is coming up. The ball sees the ground approaching.

The initial velocity the Earth's push provides is undefined and adjusts over time. In our example, it becomes cero = 0 when the ball is lifted. The acceleration is well-defined. Minkowski's dimensional component - (t·C) well represents this.

Space-time is an incompressible fluid that constantly expands outside and inside matter. It achieves this by pushing its space-time through atoms using its dark energy until it reaches the surface of the matter. This creates a "nozzle effect" that accelerates until the flow escapes the matter. As a result, an accelerated space-time flow is experienced on Earth's surface at a rate of 9.8 m/s².

The acceleration represents the force that a mass object will experience according to Newton's second law: F=ma.

In the previous upward ball example, there are only vertical vector components, and the space-time displacement always refers to accelerated expansion. Let us now consider the ballistic case, where there is a transverse component to the movement of space-time that is vertical (Figure 2.5).

Figure 2.5: The parabolic curve is due to the space-timeflux

As the ball descends in free fall, it maintains a constant horizontal velocity, tracing a straight path. Its vertical motion is the Earth moving seemingly upward. However, it is not the surface of the Earth that moves beneath it, but the space-time flow itself. From the ball's perspective, the ground approaches as the space-time flow, with its coordinates, converges, accelerating toward it.

In relativity, the curvature of space-time follows a parabolic shape, which is also a geodesic path.

The ball's translational velocity affects the curvature of space-time. The same happens to light as a wave with propagation energy. The elements follow a geodesic trajectory. The elements always believe that their motion is in a straight line.

In the expanding curved trajectories, these bodies follow lines that do not affect their stable inertia (Inside a fluid medium with different accelerations). In all astronomical objects, the effect of the broadening is because of the space-time flux coming out of matter. It is an apparent expansion of matter.

In free fall, objects experience coordinate acceleration due to the curvature of space-time but do not possess intrinsic acceleration. Therefore, an object in free fall is at rest, as gravitation does not cause it to accelerate, resulting in zero acceleration. The object will undergo the coordinate's acceleration but no acceleration of its own and thus no 'g' force.

There is no force of attraction; the object in free fall does not accelerate; it is the apparent approach of

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

the earth or its coordinates approaching it at an increasing rate. The space-time flow coming out from Earth.

When you throw a stone, it falls to the ground because the Earth appears to be widening, accelerating the surface towards the rock. However, Earth is not expanding; space-time flows outwards from the Earth in a radially accelerated form.

If you throw the stone with more force, it will fall farther. Adding a mechanism to aid in throwing will result in an even greater distance. (Figure 2.6).

Figure 2.6: The orbit is a form of parabolic fall

When the experiment is repeated, the stone will fall farther and farther with increasing momentum until its fall exceeds the curvature of the Earth's sphere.

Thus, the stone will always fall, but it will not touch the surface of the Earth since it will not find it; therefore, it will remain revolving around the Earth. One object orbiting another falls freely in perpetuity (Without considering resistance). This is a satellite.

The stone will always fall towards the Earth. However, it can miss the surface and start orbiting around the Earth with enough velocity. Such an object is known as a satellite.

Foundation: Gravitational, Not Attraction: Newton's law of universal gravitation states that objects with mass attract each other. It's what it seems and works, but it's different; we delve deeper into Einstein's insights.[10] Wheeler (1973). Gravitation.

The phenomenon isn't attraction but involves the creation of space-time flow, akin to a nozzle effect, accelerating radially around massive objects like the Sun. In addition, the sun's kinetic energy trajectory moves the space-time fluid around it, causing the planets to revolve around it.

Orbital Dynamics: Viewing space-time around the Sun as a dynamic fluid, the absence of viscosity and matter eliminates the traditional notion of "pushing" against a substance. Instead, stellar objects displace the space-time as they move through it. This displacement is driven by the Sun's kinetic energy and the radial space-time flux, illustrating how celestial bodies orbit around the Sun, creating the curvature of space-times table geodesic orbits for planets.

Elliptical Trajectories are Geodesics: The curvature of space-time dictates the paths of celestial bodies. The complex interaction between the accelerated space-time fluid coming out from the massive objects and their translation motion.

Stable Motion: Celestial bodies maintain stability within the space-time fabric when in a free-fall state. This stability is achieved through a delicate equilibrium between their inherent inertia and the gravitational space-time flux exerted upon them. As a result, their velocity, both in magnitude and direction, experiences negligible change.

Resultant Curvature: The accelerated space-time flow propelled from all massive objects involved results in the overall dynamic curvature of space-time.

Expansion of the Universe: The expansion of the universe also contributes to the overall dynamics of celestial objects; this orbital mechanics structure provides a phenomenon logical explanation.

h) Orbital Gravity

Orbital gravity is a geometrical characteristic of space-time. When two objects are involved, as in the case of the earth and the moon, the tangential velocity and its differential radial components must be considered to add them to the approach velocities of both massive objects and thus establish their geodesic. All these geodesic trajectories can be analyzed as hydrodynamics because space-time behavior is like fluid within the space-time flux.

In this and all the cases, the curvature of space-time is like a fluid that moves for two reasons: by the space-time flux coming out through surfaces of the massive bodies and by the kinetic energy of the mass by their movement, the curvature is the resultant vector. Field equations are part of the component of the Einstein stress-energy tensor. [11] (Stephani et al., 2003).

In our subsequent publication, we will provide a detailed analysis of orbital gravity. This will include a deeper explanation of the elliptical orbit paths, which are geodesics.

Geodesic trajectories or paths are curves representing the shortest distance (arc) between two points. Every orbit is a geodesic path. The distribution of space-time flux and the object's velocity, concerning that distribution of space-time flux, make the geodesic shape of any object move along. Massive objects travel along a straight line in curved space-time.

In "free fall," objects in orbit experience no acceleration, a state known as "zero gravity" ("zero-g"), which produces a sensation of weightlessness.

Any object falling or orbiting the Earth, such as artificial satellites or objects dropped, which in practical physics does not include the difference in mass because it is negligible compared to that of the Earth. This is the case of the property observed by Galileo, which is that objects of different masses fall with the same velocity, ignoring air resistance. [12] (Adler, 1978).

III. Conclusion

The space-time flow out of massive bodies integrates the classical, relativistic, and quantum points of view.

As we now understand, weight is not a force of attraction but a push, given the space-time flow. Integrating various aspects we discussed, like the expansion of the universe and the relationship with space-time, can revolutionize our understanding of gravity and the cosmos, opening up new avenues for exploration and discovery.

Einstein's theory of relativity offers a profound and inspiring perspective on the nature of gravity.

Gravity is often simplified by saying it is the curvature of space-time. However, this explanation only captures part of its meaning. One must consider the dynamic interactions between matter and space-time flow, both inside and outside matter, and their interaction with objects that are not just massive.

The concept of gravitational equipotential surfaces, characterized by concentric spheres of uniform acceleration around massive objects, provides a visual representation of the curvature of space-time. This curvature, in conjunction with the translational kinetic energy of celestial bodies, gives rise to the observed elliptical trajectories known as geodesics.

As it happens in the whole space-time, also in the interior of atoms, space-time expands, giving rise to a flow in the form of a nozzle. This space-time flow is an accelerated jet emanating from the electrons-cloud space-time of atoms.

Our conception of gravity was born from Einstein's principle that weight and inertia are essentially the same. In summary, weight results from inertia pushing upward rather than being attributed to the pull of gravity.

Einstein's realization that gravity and acceleration are fundamentally indistinguishable underscores the profound unity in the foundation of the cosmos. The underlying principle remains the same whether one experiences gravitational pull or acceleration.

In our proposal to generalize the Minkowski metric to accommodate astronomical motions within flat space-time, we aim to reconcile the apparent curvature of elliptical trajectories with the intrinsically straight trajectories delineated by geodesic motion. This may provide a new perspective for understanding the universe by shedding new light on gravitational physics.

At the heart of this understanding lies the recognition that within atoms, space-time expands, generating a flow akin to a nozzle effect, which manifests as an accelerated jet emanating from matter's atoms. This accelerated flow, characterized by its indeterminate velocity yet consistent acceleration, shapes the gravitational field surrounding massive objects.

Exploring novel concepts and theories is crucial for scientific advancement, driving us toward new frontiers of knowledge and understanding. As we delve into uncharted territories, the idea of gravitational shock waves holds promise, potentially guiding the endeavors of institutions like the LIGO observatory in unraveling the mysteries of the cosmos. In this spirit of discovery, I urge continued research and exploration into the dynamics of gravity and space-time. Let us harness the collective power of scientific inquiry and collaboration to deepen our comprehension of the fundamental forces shaping the universe.

Accepting the analogy of space-time behaving akin to a liquid devoid of viscosity could offer insights into its peculiar behaviors, echoing Einstein's characterization of quantum entanglement as 'spooky action at a distance.' This comparison suggests that space-time may possess dynamic properties analogous to those observed in fluids, potentially shedding light on phenomena like entanglement, where particles instantaneously influence each other's states regardless of distance. Embracing this perspective may lead to a deeper understanding of the underlying mechanics of quantum phenomena and provide avenues for reconciling quantum mechanics with Einstein's theory of general relativity.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

This theory challenges traditional notions of gravity, suggesting that it is not solely a force exerted by massive objects but a manifestation of the intricate interplay between space-time curvature and dynamic flows. Our proposal presents an alternative lens to view gravitational phenomena, inviting further exploration and investigation.

References Références Referencias

1. (Santos-Pereira, 2021). Santos-Pereira, O. L., Abreu, E. M. C., & Ribeiro, M. B. (2021). Fluid Dynamics in the Warp Drive Space-time Geometry. The European Physical Journal C, 81, Article No. 133. https://www.researchgate.net/publication/348832549
   https://doi.org/10.1140/epjc/s10052-021-08921-3
2. Kolecki (2003). On the expansion of the universe On the EXPANSION of the UNIVERSE (nasa.gov) https://www.grc.nasa.gov/www/k-12/Numbers/Math/documents/ON_the_EXPANSION_of_the_UNIVERSE.pdf
3. (Siegel, 2023). Siegel, E. (2023, November 3). Ask Ethan: What Drives the Expansion of the Universe? Big Think. https://bigthink.com/starts-with-a-bang/what-drives-expansion-universe/
4. (Virtual particle, 2024. Wikipedia). Virtual particle - Wikipedia https://en.wikipedia.org/wiki/Virtual_particle#:~:text=A%20virtual%20particle%20is%20a,short%20time%20and%20space%20ranges
5. Thalman, B. (2024Thalman, B. (2024). Dark Energy in Gravity. Open Journal of Philosophy, 14, 201-223. https://doi.org/10.4236/ojpp.2024.141016
6. Thalman, B. (2023). Gravity Is Not Attraction; It's a Push. Open Journal of Philosophy, pp. 13, 48–75. https://doi.org/10.4236/ojpp.2023.131004
7. Gravity and acceleration are the same thing. (n.d.). Publication Date: January 25, 2016. Retrieved from: https://www.pbslearningmedia.org/resource/nvem-sci-gravityacc/wgbh-nova-inside-einsteins-mind-gravity-is-acceleration/
8. Physics of the Universe. (n.d.). General Relativity and Quantum Cosmology. Publication Date: January 29, 2024. Retrieved from: https://www.physicsoftheuniverse.com/topics_relativity_gravity.html#:~:text=Einstein's%20ground%2Dbreaking%20realization,the%20%E2%80%9Cprinciple%20of%20equivalence%E2%80%9D.
9. Einstein, A. (2001). Relativity: The Special and General Theory. Translated by Robert W. Lawson, M.Sc. University of Sheffield. https://www.f.waseda.jp/sidoli/Einstein_Relativity.pdf
10. Wheeler, J. A., Misner, C. W., & Thorne, K. S. (1973). *Gravitation*. San Francisco: W.H. Freeman.
11. (Stephani et al., 2003). Stephani, H., Kramer, D., MacCallum, M. A. H., Hoenselaers, C. A., &Herlt, E. (2003). Exact Solutions of Einstein's Field Equations (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511535185
12. (Adler, 1978).Galileo and the Tower of Pisa Experiment Adler, C. G., & Coulter, B. L. (1978). Galileo and the Tower of Pisa Experiment. American Journal of Physics, 46,199-201. https://doi.org/10.1119/1.11165https://ui.adsabs.harvard.edu/abs/1978AmJPh..46..199A/abstract

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 24 Issue 3 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed Interenational Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Universe is Ether based Single Instruction Quantum Computer his Activity Creates Matter and Life

By Pavle Vesić

Abstract- Universe is actually gigant quantum computer (Seth Lloyd) made of ether – multicoloured, multilayered superconductor (Frank Wilczek). Ether constantly creates elementary particles (electron and proton), which are subjet of universe quantum computer macro instruction – Charge Neutralization Process –CNP. After matter creation (periodic table of elements), single cell organisms and life itself (rna and dna) emerged.

Keywords: *ether, electron, proton, neutron, cell, rna, dna, neuron.*

GJSFR-A Classification: *LCC: QC174.17.E84*

UNIVERSEISETHERBASEDSINGLEINSTRUCTIONQUANTUMCOMPUTERHISACTIVITYCREATESMATTERANDLIFE

Strictly as per the compliance and regulations of:

Universe is Ether based Single Instruction Quantum Computer his Activity Creates Matter and Life

Pavle Vesić

Abstract- Universe is actually gigant quantum computer (Seth Lloyd) made of ether – multicoloured, multilayered superconductor (Frank Wilczek). Ether constantly creates elementary particles (electron and proton), which are subjet of universe quantum computer macro instruction – Charge Neutralization Process –CNP. After matter creation (periodic table of elements), single cell organisms and life itself (rna and dna) emerged.

Keywords: ether, electron, proton, neutron, cell, rna, dna, neuron.

I. Matter and Life Formation

Matter consists of elementary particles (electrons and protons) and neutrons, which is neither particle nor elementary but temporary energy constructs which CNP needs in order to establish and mantain atoms neutrality. All atoms in Periodic Table of Elements (PTE) are electricaly neutral. All atomic products (molecules, compaunds and so on) are neutral, too. First life examples(single cell world) and multiple cell organisms (homosapiens, too) strongly manifest their electrical neutrality.

a) *What Is CNP?*

Charge neutralisaton process – CNP is ether energy macro routhine which is able to create energy products in order to establish and maintain charge neutrality of new created material entity. First example of CNP were hydrogen and deuterium production.

Figure 1. is model of hydrogen atom, where electron, toroidal energy circulation, keeps proton in centre of energy circular rotation. Proton is toroid, too. This is example of hydrogen atom without neutron.

b) *What are electrons and protons?*

Electrons and protons are elementary particles, consisting of two energy vortex fluxes in resonant state.

Rather than leading a nebulous existence as a supposed particle, wave, cloud, cavity, or "point particle in a cloud of probable locations", it is best understood as a "precise toroidal volumetric flux structure" of electric energy resulting from two longitudinal waves being superimposed upon and trapped with each other, "that occupies the location of the entire 'cloud' ."

Author: e-mail: pavlevesic@gmail.com

The total electron flux path can be divided into 19,206 rings, a number equal to the reciprocal of the fine-structure constant squared (α^{-2}).

Proton mass = 1836 times electron mass.

$$\lambda_p = 1836\ \lambda_e$$

Their decay time is more than four billion years.

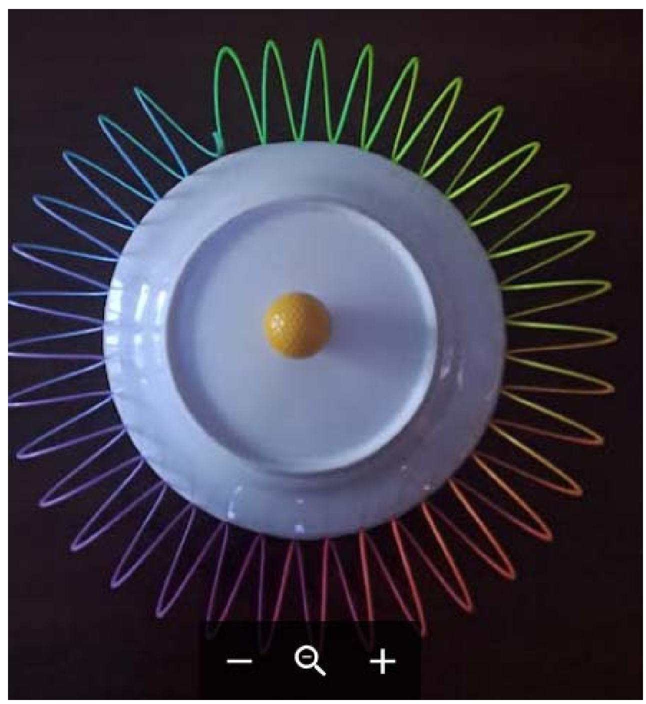


Fig. 1

CNP was able to establish hydrogen neutrality forcing proton to the center of sphere, mantain that neutrality in time interval which is defined by Compton electron frequency. It is of high importance to notice that single hydrogen atom neutrality is subject of two sinchronous energy circulation. Material neutrality in whole universe is maintained by CNP – something what only quantum computer cosmic dimensions can do.

But, CNP was not able to neutralise all electron-proton pairs in the universe due to local ether energy instability. On some surface points of globular space, which is occupaid by hydrogen atoms, charge

Global Journal of Science Frontier Research (A) Volume XXIV Issue III Version I Year 2024

neutralisation was not posible and an additional energy construct was introduced – NEUTRON.

Neutron is dedicated energy construct which has to add missing charge on the envelope of material entity. Missing charge means that in some spacetime envelope point is not possible to establish charge neutrality. Missing charge can be negative or positive so neutron energy circulation must be able to, depending of time and position, act as electron or proton.

The moment of neutron creation is the highest CREATIVITY manifestation in the whole universe. That is the explanation why all what we see emerged and have existing shapes and characteristics.

All other PTE have neutrons in his core. Depending of the number of electrons and protons, especially of electron orbitals position, CNP will add as many neutrons as it is necessary. Helium has two electrons, two protons and two neutrons – something what we expected. But mercury has 80 electrons, 80 protons and 120 neutrons! CNP created 120 neutrons (all of them are different) in order to make mercury atoms neutral.

$_{2}$He Helium 4.0026

$_{80}$Hg Mercury 200.59$_{281832182}$

Universum is the closed energy system, in many aspects infinite but has finite potentiality, so the last element in PTE has 118 electrons.

How do we know that neutron are temporary energy constructs?

Free neutrons decay in 15 min.

While neutrons are stable inside many nuclei, free neutrons decay with a lifetime of about 15 minutes. This makes them a radiation problem around nuclear reactors, since they can leak out of the reactor and decay. *The neutron decays into a proton, an electron, and an antineutrino of the electron type.*

But some recent experiments give additional information regarding neutron decay. Fig 2.

Neutron decay will produce two *energy chunks* equal to the electron and proton but *not* the particles itself. These two energies will go back to ether, the source from which CNP created them.

Standard model tell us the same, quarks are temporal "particles" with very short decay time.

Further matter creation is done on the same principles by CNP.

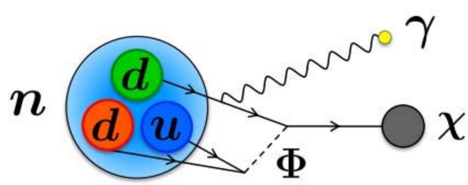


Fig. 2: Neutron dark decay $n \rightarrow \chi\gamma$ in Model 1.

The fundamental postulate of neutron decay cosmology is that each and every neutron which crosses/contacts an event horizon becomes the vacuum energy for a single planck rotation/moment and then re-emerges in lowest energy points of space. Moving from highest energy density conditions to lowest.

II. Pre Life World

Prerequisite for any existence is successful CNP. First single entities having membrane - envelope, had to demonstrate charge neutrality which is generated by CNP.

Single cell organisms are very complicated energy based products, but we know how they emerged.

Universe ether energy is already described as a multilayered, multicolored superconductor.

Einstein and De Broglie described energy with next equations:

$$E=mc^2 \; ; \; E=hf$$

It is well known fact regarding electron mass to lenght proportionality.

Mass to length conversion – Length = λe = $m_e N_a$ 10^{-2} it meters, Na-Avogadro's number,

$$E = m_e c^2 = \int = \lambda e \, c^2$$

$$E(=) \, l^3 t^{-2}$$

Last equation tell us that energy (E) produces space (l**3 – three length dimensions – Decartes coordinate system) and time (t**-2). There is not something like empty space where we can put something, energy = space time.

Term t**-2 (time on power of minus two) represents the unit of ether (particle) which has a globular shape defined by two vorteces cycling with the speed of light. Ether „particle" has no mass, it is pure energy – light itself.

Ether is pure energy, electron and proton are made of two trapped vortexes in resonant state, neutron are ether energy product. That explains Frank Wilczek book title : "The Lightness of Being: Mass, Ether and the Unification of Forces."

Energy cycles and minimum cycling quantity (one full rotation) is photon. All particles (electron, proton and neutron) are made of photons. All pre life and life world is made of photons. Photon is the basic energy transfer unit.

Single cell organisms have membranes which define the spots where charge neutrality is manifested. Every membrane is made of specifically arranged atoms whose valence electrons take the highest energy level(s). Incoming photons add energy to valence electrons that violate charge neutrality of the whole cell. CNP reaction is creation of cell internal modification equal to incoming photon energy but opposite in charge (conjugate), previously detected in valence electrons. Charge neutrality is established promptly-with Compton frequency rate.

III. RNA and DNA Creation

Incoming energy is exclusively photon energy. Sound, also, next to the cell valence electrons, appear as photon and do the same as described in previous paragraph. The same mechanism acts with all other senses.

If we look at a single cell in normal environment a lot of different photon energy manifestation will influence valens electrons. As a common result, CNP will respond to all of them creating internal structure which will neutralise external influence. If external influence lasts long enough, internal structure will be made permanent – RNA. When external influence stops, already generated RNA will cause instability from inside. CNP react promptly – all RNA bases are conugated and – DNA is created.

When cell internal energy reaches the threshold level – DNA structure will be broken on weakest spots – hydrogen bonds. But CNP will act immediatelly – single strands (RNA) will be again conjugated in order to bring back violated neutrality, resulting in two identical DNA molecules. Cell is ready for reproduction.

a) Neuron

Neuron is the full equivalent of neutron, everyone on his level of complexity. It is amazing that the language so successfuly recognized their function. What is neutron function on the atomic level, that is neuron function on the level of multicellular organisms. When photon reach to multicellar structure some of the cells will react stronger than others (depends on the angle from which foton approches to the cell valence electrons – Compton experiment). Immedeiatelly to these cells, CNP will create coresponding material replay in sense of violated neutrality (start neuron formation). When new photons come new violation will contribute to the further neuron development. Finaly, after many such iterative cycluses, CNP will finish with multi neuronal constract (visual cortex) who is able to generate conjugate elecric image, which will fully compensate all possible photon energy valence electron violation so that every input frequency and energy level has adequate energy response. That is why we see red as red and so on.

So, the brain can not control visual processes, brain neuron activity is forced response to the external photon energy input dictated by CNP.
So do all other senses.

b) Internal neutrality violation

When we receive certain information, in our brain will be formed electric image of the subject described by that information. If the received information required our action (hit the ball) internaly formed electric image will produce internaly generated neutrality violation. That image can be canseled if our body performs such series of actions which final result is conjugate electric image, due to CNP.

How CNP can act on so many subjects with such accuracy?

We live in energy ocean (ether) which is gigant quantum computer. We are produced and maintained by him with Compton frequency rate. Our free will ends up on the content of our memory, CNP will not be able to choose right electric image if that image in not stored in our memory.

IV. Conclusion

Behind every complex design is a designer, The universe has a complex design, Therefore, the universe has a designer.

or

Nick Bostrom's Simulation Theory: We Could Be Living Inside the Matrix

References Références Referencias

1. The electric aether and structure of the electron by Paulo N Correa,M.Sc, Ph.D. & Alexandra Correa, Hon.B.A. Aurora Biophysics Research Institute, Canada.
2. Frank Wilczek The lightness of being : Mass, Ether and Unification of Forces.
3. Adan Cabelo, Dipartment de Fisica Aplicada, Universidad de Sevilla, Spain, 23. november 2016. Interpretation of quantum theory : A map of madness.
4. Oliver Consa, Independent Researcher, Barcelona, Spain : Something is rotten in state of QED.
5. A. V. Rykov, Chief of seismometry lab. Of IPE RAN, Moscow, Russia, The theory of vacuum.
6. Aharonov- Bohm: experiment, 1959.
7. Gene Gryziecki, The Torodial Fine Structure of the Electron, Global Journal of Science Frontier Research: A Physics and Space Science, vol. 23 year 2023.
8. John Hagelin, Consciousness based education.
9. Reginald T Cahill, Flinders University, Adelaide, Australia : Process Physics.
10. Jeroen van Dijk: Process Physics, time, and consciousness, Nature as an integrally meaningful habit-establishing prosess.

11. Chen Ran, Jack C Boetcher,Judit A Kaye,Catherine E Galeri, Stephen D Liberles: A brainstem map for visceral sensation, Nature 609, 320- 326 (2022).
12. Akira Tonomura: The Aharonov-Bohm effect and its applications to electron phase microscopy,

Proceedings of the Japan Academy, Series B
Physical and Biological Sciences

Proc Jpn Acad Ser B Phys Biol Sci. 2006 Apr; 82(2): 45–58. doi: 10.2183/pjab.82.45

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 24 Issue 3 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed Interenational Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Unveiling Novel Dark Matter Particles: Insights from Fractal Quantum Gravity Theory

By Shuming Li, Lihua Li Huang, Shuwei Li & Shuyun Li

Kansas State Department of Education

Abstract- As a promising quantum gravity theory, the newly developed fractal quantum gravity theory (FQG) has introduced the smallest constant of the product of space, time and energy of STQAs (Space-Time Quantum of Action). The product of space, time and energy of every particle is integer times of this smallest constant-STQA. Based on the FQG equation, we have deduced that every physical parameter of existing or possibly existing particle takes some special or limited extrema values.

Keywords: dark matter particles, DMP, Weakly Interacting Massive Particle, WIMPs, fractal quantum gravity, FQG, Space-Time Quantum of Action, STQA, Large Hadron Collider (LHC).

GJSFR-A Classification: *LCC: QB981 + QC173.96*

UNVEILINGNOVELDARKMATTERPARTICLESINSIGHTSFROMFRACTALQUANTUMGRAVITYTHEORY

Unveiling Novel Dark Matter Particles: Insights from Fractal Quantum Gravity Theory

Shuming Li α, Lihua Li Huang σ, Shuwei Li ρ & Shuyun Li ω

Abstract- As a promising quantum gravity theory, the newly developed fractal quantum gravity theory (FQG) has introduced the smallest constant of the product of space, time and energy of STQAs (Space-Time Quantum of Action). The product of space, time and energy of every particle is integer times of this smallest constant-STQA. Based on the FQG equation, we have deduced that every physical parameter of existing or possibly existing particle takes some special or limited extrema values.

With the calculation of the minimum value of electric charge that a particle can carry, its magnetic moment, mass, inherent speed, the space size and spin angular momentum, we have discovered a very intriguing brand-new type of particles. Its electric charge is about 1/10 of electrons', and the magnetic moment is 1.18×10^{-9} of electrons'. Its mass is 324 times of the mass of the known existing heaviest particle, the top quark. Its inherent speed is about 10^{-3} of electrons', space size is about 10^{-10} of electrons' and its spin is 1.38 times of the spin of electrons. According to the popular thinking about the characteristics of dark matter that are electromagnetically neutral, heavy, slow-moving particles, we believe that this newly discovered particle should be the weakly interacting massive particles (WIMPs), a most promising type of the dark matter particles (DMPs). This is the first time that the specific physical parameters of DMPs have been calculated. These predictions not only provide much insight into the understanding of dark matter, it also makes it possible to explore the experimental verification, possibly using the Large Hadron Collider (LHC) in the future.

Keywords: dark matter particles, DMP, Weakly Interacting Massive Particle, WIMPs, fractal quantum gravity, FQG, Space-Time Quantum of Action, STQA, Large Hadron Collider (LHC).

I. Introduction

Dark matter's existence was first inferred by Swiss American astronomer Fritz Zwicky in 1933, who discovered that the mass of all the stars in the Coma cluster of galaxies provided only about 1 percent of the mass needed to keep the galaxies from escaping the cluster's gravitational pull. The reality of this missing mass remained in question for decades, until in the 1970s when American astronomers Vera Rubin and W. Kent Ford confirmed its existence by the observation of a similar phenomenon. The mass of the stars visible within a typical galaxy is only about 10 percent of that required to keep those stars orbiting the galaxy's center. In general, the speed with which stars orbit the center of their galaxies is independent of their separation from the center; indeed, orbital velocity is either constant or increases slightly with distance rather than dropping off as expected. To account for this, the mass of the galaxy within the orbit of the stars must increase linearly with the distance of the stars from the galaxy's center. However, no light is seen from this inner mass — hence the name "dark matter."

Commonly observable matter accounts for only 30.6 percent of the universe's matter-energy composition. Only 0.5 percent is in the mass of stars and 0.03 percent of that matter is in the form of elements heavier than hydrogen. The rest is dark matter. Two varieties of dark matter have been found to exist. The first variety is about 4.5 percent of the universe and is made of the familiar

Author α: Kansas State Department of Education, 900 SW Jackson St Suite 351, Topeka, KS 66612, USA. e-mail: lishuming@gmail.com
Author σ: 303 Ray St., Pleasanton, CA 94566, USA. e-mail: lihuah@gmail.com
Author ρ: Livermore, California 94550, USA. e-mail: wei.fflsw@gmail.com
Author ω: Shijiazhuang, P.R. China. e-mail: lsylag@eyou.com

baryons (i.e., protons, neutrons, and atomic nuclei), which also make up the luminous stars and galaxies. Most of this baryonic dark matter is expected to exist in the form of gas in and between the galaxies. The dark matter that comprises the other 26.1 percent of the universe's matter is in an unfamiliar, nonbaryonic form. The rate at which galaxies and large structures composed of galaxies coalesced from density fluctuations in the early universe indicates that the nonbaryonic dark matter is relatively "cold" or "non-relativistic", meaning that the backbones of galaxies and clusters of galaxies are made of heavy, slow-moving particles. The absence of light from these particles also indicates that they are electromagnetically neutral. These properties lead to the particles' common name, weakly interacting massive particles (WIMPs).

The precise nature of these particles is not currently known, and they are not predicted by the standard model of particle physics. However, a number of possible extensions to the standard model such as supersymmetric theories predict hypothetical elementary particles such as axions or neutralinos that may be the undetected WIMPs [1]. Dark matter problem is one of the biggest mysteries in modern physics.

Quantum theory and the theory of relativity has given us a deeper understanding of the properties of matter and the nature of space and time. However, due to the lack of new physical framework, the research on unifying relativity and quantum mechanics has been unable to make desirable progress. Through many years of hard work, we have introduced a novel framework, a new theory ─ the fractal quantum gravity (FQG) theory. FQG theory suggests that there is a smallest constant of the product of the energy, space interval, and time interval – Space-Time Quantum of Action (STQA). The product of the energy, space interval, and time interval of a particle is the integer times of this smallest constant STQA. Combined with fractal geometry, the fractal quantum gravity (FQG) equation is created and can prove that every particle or physical system consists of these smallest units (STQAs) in a fractal structure [2]-[4].

There are abundant physical meanings behind the fractal quantum gravity (FQG) equation with a simple and elegant format. All the physical parameters of a particle or a physical system can be calculated using the FQG equation. Through mathematical derivations, many more important predictions can be obtained. There is a transformation between current physical parameters and FQG parameters. All matter in the universe consist of various STQA sets in fractal microstructure, including black holes and the common state of matter in the universe. We have obtained a framework that work both microscopically and macroscopically.

From a spatial perspective, a particle is neither a point of classical mechanics nor a wave of quantum mechanics. A particle is a group of STQAs that are distributed in space in a fractal pattern that is similar to the wave function pattern; however, the fractal pattern can define a particle's spatial distributions that do not need a probability explanation of a wave function. Thus, we can provide a new approach to explain wave – particle duality that reconciles the controversy between the locality of Einstein and the non-locality of Copenhagen.

We have shown that the fractal quantum gravity equation satisfies almost all the requirements of quantum gravity theory. The general relativity is an approximation of the FQG equation when the quantum effect is negligible, while the quantum theory is an approximation of the FQG equation when the interaction between space, time, and energy is very weak or negligible. In other words, it looks promising that we may have discovered a novel way to unite the quantum theory and general relativity. Therefore, fractal quantum gravity theory is a promising self-consistent quantum gravity theory.

It is quite amazing that there is no infinity in FQG. Every physical parameter can be calculated, and their value is limited and reasonable. This is a huge advantage for FQG as a physical theory that it can make so many predictions to solve many of the challenging problems in modern physics. The standard model of elementary particle physics theory is one of the most successful theories of modern physics. Through standard model, we have discovered 17 elementary particles [5]. In FQG point of view, these 17 elementary particles are not really elementary particles, but they still consist of more basic unit of STQAs.

We can transform the physical parameters, such as mass, electric charge, magnetic moment and spin angular momentum into the FQG parameters of space, time, energy and the numbers of STQAs, the a, b, d and n. After drawing a map of the relationship of a, b, d and log n, we discovered that there are five lines in the map that corresponding to five equations about a, b, d and log n for heavy particles and leptons. Then we can deduce that the FQG parameters of every particle or physical system in the universe should fit in these five equations. By extending the range of calculations, we have discovered that every physical parameter of FQG corresponding to one or more limited extrema values that should be the parameters of the possibly existing particles.

During the calculation of the extrema value of electric charge, we found that there is a very tiny electric charge carried by the particle that is about 1/10 of the electrons. After the calculation of its mass, spin angular momentum, inherent speed and magnetic moment, we have discovered that it has very small magnetic moment, very big mass, slow inherent speed and very special spin angular moment. It seems to be a very special particle, which is comparable with the most popular thinking about the characters of dark matter that are electromagnetically neutral, heavy, slow-moving particles, the weakly interacting massive particles (WIMPs). We think that this newly calculated particle should be the dark matter particles (DMP) or (WIMPs).

There are many possible candidates for dark matter: hypothetical particles such as axions, sterile neutrinos, weakly interacting massive particle (WIMPs), supersymmetric particles, atomic dark matter, or geons; and primordial black holes. Among these the weakly interacting massive particle (WIMPs) is most likely candidate of dark matter particles [6]. This is the first time that the specific physical parameters of the particles have been calculated and match all the descriptions of WIMPs. We will describe the detailed calculations in the following chapter.

II. The Calculations of the Physical Parameters of DMP (Dark Matter Particles)

Based on the fractal quantum gravity (FQG) theory, we have the FQG equations [4]:

$$E = E_0 n^a, x = x_0 n^b, \tau = \tau_0 n^d \tag{1}$$

$$a + b + d = 1 \tag{2}$$

$$Ex\tau = nk_0 \tag{3}$$

Where E is the energy, x is the space interval, τ is the time interval of a particle. And

$$x_0 = \sqrt{\frac{Gh}{2c^3}} = 2.86437\times10^{-33}\ \text{cm}$$

$$\tau_0 = \sqrt{\frac{Gh}{2c^5}} = 9.55451\times10^{-44}\ \text{s}$$

$$E_0 = \sqrt{\frac{hc^5}{2G}} = 3.46751\times10^{16}\ \text{erg} = 2.1\times10^{19}\ \text{GeV}$$

$$k_0 = E_0 x_0 \tau_0 = \sqrt{\frac{Gh^3}{8c^3}} = 9.48977\times10^{-60}\ \text{erg}\cdot\text{cm}\cdot\text{s} \tag{4}$$

n is a positive integer, a, b, and d are real numbers.

And

$$D_x = \frac{1}{b} = \frac{\log n}{\log(\frac{x}{x_0})} \quad , \quad D_E = \frac{1}{a} = \frac{\log n}{\log(\frac{E}{E_0})} \quad , \quad D_\tau = \frac{1}{d} = \frac{\log n}{\log(\frac{\tau}{\tau_0})} \tag{5}$$

Where D_X, D_E and D_τ correspond to the space, energy, and time fractal dimensions of the particles, respectively.

For particles with rest mass, electric charge, and spin angular momentum, m is the rest mass, e is the electric charge, I is the spin angular momentum of the particles. We can obtain Eq. (6), where $A = m/m_0$, $B = e^2/e_0^2$, $D = I/I_0$, $m_0 = E_0/c^2$, $e_0 = (E_0x_0)^{1/2}$, $I_0 = E_0\tau_0$. Using Eq. (6), the values of a, b, d, and n for leptons, quarks, some bosons, and some heavy particles can be calculated, as listed in Table I.

$$a = \frac{\log A}{\log n} \quad , \quad b = \frac{\log \frac{B}{A}}{\log n} \quad , \quad d = \frac{\log \frac{D}{A}}{\log n} \quad , \quad n = \frac{BD}{A} \tag{6}$$

For particles with a rest mass, magnetic dipole moment, and spin angular momentum, we can calculate a, b, d, and n using Eq. (7), where $H = \mu/\mu_0$, $\mu_0 = (\tau_0 e_0 c)/2$, μ is the magnetic dipole moment of the particles, and c is the speed of light. Using Eq. (7), the values of a, b, d, and n for protons, neutrons, and other heavy particles can be calculated, as shown in Table I.

$$a = \frac{\log A}{\log n} \quad , \quad b = \frac{\log \frac{AH^2}{D^2}}{\log n} \quad , \quad d = \frac{\log \frac{D}{A}}{\log n} \quad , \quad n = \frac{AH^2}{D} \tag{7}$$

And

$$m = \frac{E}{c^2} = \frac{E_0 n^a}{c^2} = m_0 n^a \tag{8}$$

$$e = \sqrt{Ex} = \sqrt{E_0 x_0}\sqrt{n^{a+b}} = e_0 n^{\frac{a+b}{2}} \tag{9}$$

$$I = E\tau = E_0 \tau_0 n^{a+d} = I_0 n^{a+d} \tag{10}$$

Where m is the mass, e is the electric charge, I is the spin angular momentum of a particle.

Based on the parameters in table I, we can draw a diagram as Fig. 1. According to this diagram, these equations can be found as follows:

For heavy elementary particles, we have the Eq. (11):

$$\begin{aligned} a &= 0.058 \lg n - 2.115 \\ b &= -0.003 \lg n + 1.099 \\ d &= -0.055 \lg n + 2.016 \end{aligned} \tag{11}$$

Based on Eq. (11), the electric charge of heavy particles can be calculated using equation as shown in Eq. (12):

$$e = e_0 n^{\frac{a+b}{2}} = e_0 n^{0.0275 lgn - 0.508} \tag{12}$$

Take logarithm

$$lge = lge_0 + 0.0275(lgn)^2 - 0.508 lgn$$

Calculate the extreme value

$$\frac{d(lge)}{d(lgn)} = 0.055 lgn - 0.508 = 0 \ \rightarrow lgn = 9.236363637$$

We get n = 1.723311×10^9. Then we can do the calculations as follows:

Calculation 1: mass, electric charge, spin, magnetic momentum, and inherent speed

particles	n	a	b	d	β	e/e0	I/I0	μ/μ0	m
electron	1.5670127E+19	-1.1717	1.0414	1.1302	2.026265E-02	0.048215	0.159150	3.25005E+20	1.24823E-27
DMP	1.7233109E+09	-1.5793	1.0713	1.5080	9.658786E-05	0.004508	0.219549	3.82296E+11	9.98783E-20
DMP/electron					4.766793E-03	0.093494	1.379509	1.176279E-09	8.00160E+07

Calculation 2: parameters of space, time, and energy

particles	n	a	b	d	D_E	D_x	D_τ	E	x	τ
electron	1.5670127E+19	-1.1717	1.0414	1.1302	-0.8535	0.9602	0.8848	1.12185E-06	2.79938E-13	4.73512E-22
DMP	1.7233109E+09	-1.5793	1.0713	1.5080	-0.6332	0.9335	0.6631	8.97661E+01	2.24834E-23	8.10298E-30

We can see that the new dark matter particle (DMP) has the minimum electric charge, its e/e_0 = 0.004508. As compared to the electric charge of electrons e/e_0 = 0.048215, the electric charge of dark matter particle is less than 1/10 of the electric charge of electrons. And the magnetic moment of the DMP is about 10^{-9} of the magnetic moment of electrons. This means that dark matter particle has very tiny electromagnetics interactions or may totally not able to join the electromagnetics interactions. The spin angular momentum of the DMP is 1.37951 times of the spin angular momentum of electrons, which means that the spin of the new particles is not the integer times of ½ or integer times of 1 in the standard model of current particle physics. It is about 20/29. This intriguing spin of DMP comes from our new theory of fractal quantum gravity, which cannot be explained by the current physics theories.

The mass of the new particle is about 10^8 times of electron's mass. We know that the heaviest detected particle is the top quark, its mass is 172.76 ± 0.3 GeV/c^2, so the mass of the new particle is 56032 GeV/c^2 or 56TeV/c^2, or about 324 times of the mass of top quark. Its inherent speed is $\beta = 9.7\times10^{-5}$, which is at a much slower speed as compared to electrons. DMP's space dimension is 0.9335, time dimension is 0.6631, energy dimension is -0.6332, and its space size is 2.24834×10^{-23} cm. This is a very huge mass, but it is still possible to detect in the experiment of Large Hadron Collider (LHC). During the shutdown of LHC between 2013 and 2015, the LHC has gone through some significant upgrades. After those upgrades, it has reached 6.5 TeV per beam (13.0 TeV total collision energy) and may expect some further upgrades [7]. The calculated absolute error is about 10^{-4} of the calculated values. These calculated values can provide significant insight to the ranges of error.

According to table I, the space size or radius of the particles can be calculated based on FQG theory. We can see that the biggest radius of the subatomic particles is the x of electrons, which is 2.8×10^{-13} cm. In the history of discovery order of subatomic particles the electron was the first discovered by J. J. Thomson in 1897. This may mean that the larger the particle size, the easier it is to detect. If that is true, beside the tiny electric charge and the magnetic moment of the DMP particle, the size may be another important factor to detect the DMP particle by experiment. Because its radius is about 10^{-10} of electrons', the DMP particle might be very difficult to produce any interaction with other particles.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

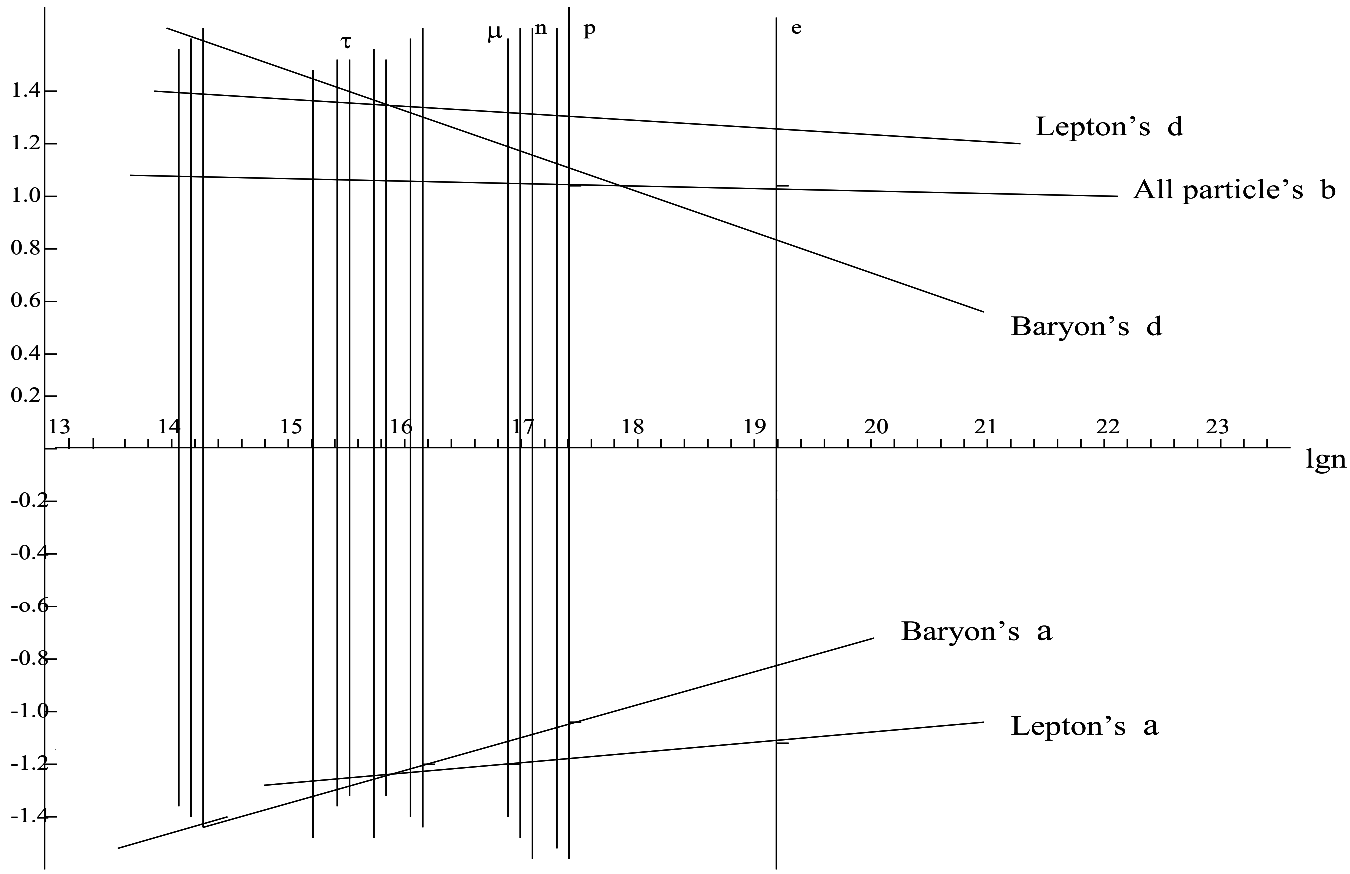


Fig. 1: The relationship between lg n and a, b, or d of elementary particles

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Table 1: The fractal parameters of subatomic particles based on the FQG equation

Particles		1	2	3	4	5	6	7	8	9	10	11
		D_E	D_x	D_τ	n	E erg	X cm	τ s	β	H(E)	H(x)	H(τ)
Leptons	$e^{\pm}$	-0.85	0.96	0.88	1.57×10^{19}	8.19×10^{-7}	2.82×10^{-13}	6.44×10^{-22}	0.0146	1.5×10^{5}	8.9×10^{-13}	2.3×10^{-19}
	$\mu^{\pm}$	-0.83	0.95	0.87	7.58×10^{16}	1.69×10^{-4}	1.36×10^{-15}	3.11×10^{-24}	0.0146	1.4×10^{3}	6.4×10^{-15}	4.6×10^{-21}
	$\tau^{\pm}$	-0.82	0.95	0.86	4.51×10^{15}	2.85×10^{-3}	8.11×10^{-17}	1.85×10^{-25}	0.0146	1.2×10^{2}	4.9×10^{-16}	6.8×10^{-22}
Quarks	u	-0.83	0.96	0.86	1.55×10^{18}	3.68×10^{-6}	2.78×10^{-14}	1.43×10^{-22}	0.0065	3.1×10^{4}	1.0×10^{-13}	1.7×10^{-19}
	d	-0.80	0.96	0.83	1.85×10^{17}	7.69×10^{-6}	3.34×10^{-15}	6.86×10^{-23}	0.0016	1.2×10^{4}	1.5×10^{-14}	4.5×10^{-19}
	c	-0.80	0.95	0.84	2.79×10^{15}	2.04×10^{-3}	5.02×10^{-17}	2.58×10^{-25}	0.0065	1.4×10^{2}	3.2×10^{-16}	2.5×10^{-21}
	s	-0.78	0.95	0.82	9.37×10^{15}	1.52×10^{-4}	1.69×10^{-16}	3.46×10^{-24}	0.0016	9.9×10^{2}	9.5×10^{-16}	7.0×10^{-20}
	t	-0.78	0.94	0.82	2.05×10^{13}	2.78×10^{-1}	3.70×10^{-19}	1.90×10^{-27}	0.0065	2.7×10^{0}	4.1×10^{-18}	1.5×10^{-22}
	b	-0.77	0.95	0.80	2.13×10^{14}	6.70×10^{-3}	3.83×10^{-18}	7.87×10^{-26}	0.0016	4.6×10^{1}	3.2×10^{-17}	8.4×10^{-21}
Heavy Particles	p	-0.90	0.96	0.94	2.66×10^{17}	1.50×10^{-3}	4.79×10^{-15}	3.51×10^{-25}	0.4554	3.5×10^{2}	2.0×10^{-14}	1.1×10^{-23}
	n	-0.88	0.96	0.92	1.25×10^{17}	1.51×10^{-3}	2.25×10^{-15}	3.50×10^{-25}	0.2142	3.1×10^{2}	1.0×10^{-14}	3.0×10^{-23}
	Λ	-0.84	0.95	0.88	1.52×10^{16}	1.79×10^{-3}	2.74×10^{-16}	2.95×10^{-25}	0.0310	2.0×10^{2}	1.5×10^{-15}	3.4×10^{-22}
	Σ^{+}	-0.90	0.96	0.94	2.61×10^{17}	1.91×10^{-3}	4.70×10^{-15}	2.77×10^{-25}	0.5667	2.9×10^{2}	2.0×10^{-14}	6.8×10^{-24}
	Σ^{-}	-0.87	0.95	0.91	5.86×10^{16}	1.92×10^{-3}	1.05×10^{-15}	2.74×10^{-25}	0.1279	2.3×10^{2}	5.1×10^{-15}	4.9×10^{-23}
	Σ^{0}	-0.89	0.96	0.92	1.12×10^{17}	1.91×10^{-3}	2.02×10^{-15}	2.76×10^{-25}	0.2445	2.6×10^{2}	9.2×10^{-15}	2.1×10^{-23}
	Ξ^{-}	-0.85	0.95	0.89	2.03×10^{16}	2.12×10^{-3}	3.66×10^{-16}	2.49×10^{-25}	0.0490	1.9×10^{2}	1.9×10^{-15}	1.6×10^{-22}
	Ξ^{0}	-0.88	0.95	0.92	7.47×10^{16}	2.11×10^{-3}	1.34×10^{-15}	2.50×10^{-25}	0.1791	2.2×10^{2}	6.3×10^{-15}	2.9×10^{-23}
	Ω^{-}	-0.89	0.98	0.90	8.27×10^{16}	2.68×10^{-3}	4.96×10^{-16}	5.90×10^{-25}	0.0280	1.9×10^{2}	9.6×10^{-16}	1.5×10^{-22}
	Λ^{+}_{c}	-0.82	0.95	0.86	3.50×10^{15}	3.66×10^{-3}	6.31×10^{-17}	1.44×10^{-25}	0.0146	9.9×10^{1}	3.9×10^{-16}	5.7×10^{-22}
Bosons	$W^{\pm}$	-0.82	0.97	0.84	1.99×10^{14}	1.29×10^{-1}	1.79×10^{-18}	8.19×10^{-27}	0.0073	5.4×10^{0}	7.1×10^{-18}	9.3×10^{-23}
	Z^{0}	-0.82	0.97	0.84	1.79×10^{14}	1.46×10^{-1}	1.61×10^{-18}	7.22×10^{-27}	0.0074	4.8×10^{0}	6.4×10^{-18}	8.4×10^{-23}
Mesons	$\pi^{\pm}$	-0.84	0.97	0.87	1.15×10^{17}	2.24×10^{-4}	1.03×10^{-15}	4.72×10^{-24}	0.0073	1.2×10^{3}	2.7×10^{-15}	6.2×10^{-21}
	π^{0}	-0.84	0.97	0.87	1.18×10^{17}	2.16×10^{-4}	1.06×10^{-15}	4.88×10^{-24}	0.0073	1.2×10^{3}	2.8×10^{-15}	6.4×10^{-21}
	k^{0}	-0.83	0.95	0.86	1.90×10^{16}	7.97×10^{-4}	3.42×10^{-16}	6.61×10^{-25}	0.0172	3.7×10^{2}	1.8×10^{-15}	1.3×10^{-21}

III. Conclusions

The newly developed theory of fractal quantum gravity has unveiled a new prediction regarding dark matter particles. Based on the physical properties of the DMP (Dark Matter Particle), it might be a very promising candidate for the Weakly Interacting Massive Particle (WIMP).

This is the very first dark matter particle with precisely calculated physical properties. Since this new particle carries very tiny electric charge which is about 1/10 of the electric charge of electron and has very small magnetic moment that is about 10^{-9} of electrons'. and its spin angular momentum is very special that is about 20/29, and its mass is very large that is about 56 TeV/c^2.

Our calculation not only provides much insight into the understanding of dark matter, it also makes it possible to explore the possibility of experimental verification. Between 2013 and 2015, the Large Hadron Collider (LHC) was shut down and went through further upgrades. With the most recent upgrades, it can reach 6.5 TeV per beam (13.0 TeV total collision energy) and expect further upgrades that may be reaching 56TeV total collision energy. It is hopeful that the newly discovered DMP particle can be detected in LHC in the near future.

However, there might be a concern that the size of the particle affects the interaction between particles. Since the DMP particle's space size is so small, it may penetrate the gap inside any particle without interaction with the particle at all, this may cause the detector's incapability to capture the DMP particle even when the total collision energy reached 56TeV and generated a DMP particle in LHC. Plus, the DMP particle does not carry much electric charge and magnetic moment. It might present a big challenge for detecting DMP in LHC.

We hope that this paper can draw more attention of many researchers to collaborate with each other to study more deeply to find the approaches to detect this new particle. It is promising that we can work together to solve the mysteries of the dark matter. Furthermore, we can solve the mysteries of dark energy and many other challenges.

Funding Statement: The study has no funding.

Ethical Compliance: The study was approved by the Ethics Committee of Example University.

Data Access Statement: Research data supporting this publication are available in this document.

Conflict of Interest declaration: The authors have declared that no competing interests exist.

References Références Referencias

[1] Riess, Adam. "Dark matter". Encyclopedia Britannica, 11 Mar. 2024, https://www.britannica.com/science/dark-matter

[2] Shuming L, Lihua LH, Shuwei L, et al. The smallest constant of physics. *Phys Astron Int J*. 2023;7(2):99-102. DOI: 10.15406/paij.2023.07.00291

[3] Shuming L, Lihua LH, Shuwei L, et al. Space-time curvature and cosmic evolution. *Phys Astron Int J*. 2023;7(2):137-139. DOI: 10.15406/paij.2023.07.00298

[4] Shuming L, Lihua LH, Shuwei L, et al. The Fractal Quantum Gravity. *Reports in Advances of Physical Sciences*. 2023;07: 2350011. DOI: https://doi.org/10.1142/S2424942423500111

[5] The Standard Model | Institute of Physics (iop.org)

[6] https://phys.org/news/2018-04-small-dark-baffling-candidates.html

[7] Large Hadron Collider - Wikipedia

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 24 Issue 3 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed Interenational Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Half-Silvering Dimensions

By Dr. Kaiden Jones

Introduction- Half-silvering Dimensions" E ach dimension having a distinctive boundary called a "Halfsilvering" that acts like a two-way mirror. This means that beings or objects existing in a Higherdimensional space can look down into lowerdimensional spaces but cannot see or perceive the higher-dimensional spaces above them. For example, entities in 3D can observe and interact with 3D, 2D, and 1D, but they cannot see or comprehend dimensions beyond 3D.

GJSFR-A Classification: LCC: QA614.58

HALFSILVERINGDIMENSIONS

Half-Silvering Dimensions

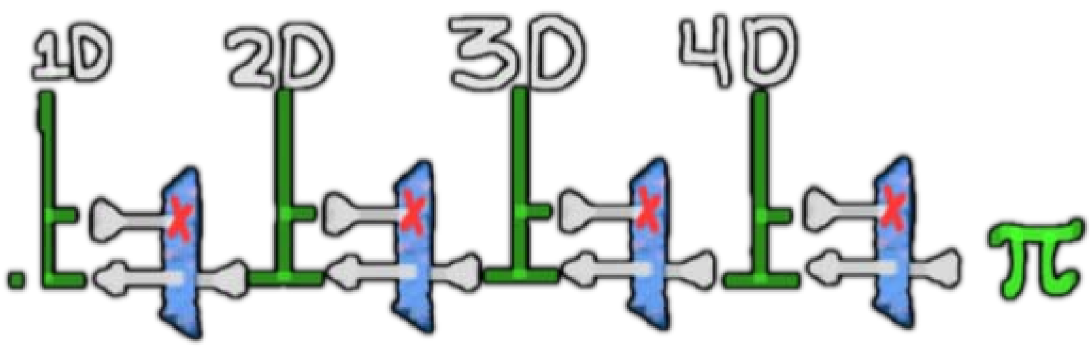
Dr. Kaiden Jones

I. Introduction

"Half-silvering Dimensions" Each dimension having a distinctive boundary called a "Half-silvering" that acts like a two-way mirror. This means that beings or objects existing in a higher-dimensional space can look down into lower-dimensional spaces but cannot see or perceive the higher-dimensional spaces above them. For example, entities in 3D can observe and interact with 3D, 2D, and 1D, but they cannot see or comprehend dimensions beyond 3D.

To develop this concept further, we could consider the implications and characteristics of these "half-silvering" boundaries:

1. *Dimensional Perception:* Beings or objects within a particular dimension can perceive and interact with dimensions below them but lack awareness or comprehension of dimensions above them. This limitation might be due to the inherent nature of their existence within a specific dimension.
2. *Transitioning Across Dimensions:* Travel or movement between dimensions could occur by crossing the "half-silvering" boundaries. For example, a 3D entity could pass through the 2D boundary and enter the 2D space, but it would be unable to perceive or interact with 3D space once it has crossed the boundary.
3. *Properties of "Half-silvering" Boundaries:* These boundaries might possess unique properties, such as being impermeable to certain types of energy or matter. This characteristic would maintain the integrity and separation between dimensions.
4. *Limitations and Constraints:* Each dimension may have specific laws and properties governing its behavior, which might influence the interactions and possibilities within that dimension. These laws could differ from one dimension to another.
5. *Multidimensional Observatories:* Beings or technologies residing in higher dimensions could create observatories or devices capable of peering into lower dimensions. These observatories would exploit the two-way mirror effect of the "half-silvering" boundaries to observe and study the dimensions below.
6. *Higher-dimensional Existence:* Exploring the concept of dimensions beyond 3D raises intriguing questions about the nature of higher-dimensional existence and the potential laws that govern those dimensions.



See Above: "Half-silvering dimensions" Diagram

a) *Positive Implications*

Expanding Our Understanding: The theory presents an opportunity to broaden our understanding of the universe by exploring dimensions beyond our current grasp. It offers a framework for investigating higher dimensions and the laws that govern them, potentially revealing profound insights into the nature of reality.

Interdimensional Communication: Imagine the potential for communication and interaction between beings residing in different dimensions. By deciphering the mechanics of these "half-silvering" boundaries, we may uncover ways to establish communication channels, exchanging knowledge and perspectives with entities existing in other dimensions.

Author: Ph. D, Doctor of Philosophy in the field of Metaphysics.
e-mail: kaidentoomzy@gmail.com

Novel Technological Applications: Research into the "Half-silvering Dimensions" theory could lead to the development of technologies that enable observation and manipulation of lower-dimensional spaces. Such advancements could have applications in areas such as materials science, quantum computing, and data storage.

Multidimensional Observatories: Building upon the theory, we could envision the creation of observatories capable of peering into lower dimensions, offering unprecedented insights into the workings of lower-dimensional realms. This could pave the way for discoveries and advancements previously unimaginable.

b) Challenges and Negative Implications

Practical Limitations: Exploring dimensions beyond our own presents immense challenges due to our inherent 3D existence. It would require innovative approaches, sophisticated technologies, and a profound shift in our scientific methodologies to overcome these limitations.

Ethical Considerations: As we delve into the realm of higher dimensions, ethical dilemmas may arise. How would contact with beings from lower dimensions affect their societies and development? It is crucial to address these ethical concerns and ensure responsible exploration and interaction.

Paradigm Shift: Accepting the "Half-silvering Dimensions" theory demands a paradigm shift in our understanding of reality. Scientists may face scepticism and resistance from those rooted in traditional frameworks. However, history has shown that scientific progress often emerges from bold ideas that challenge prevailing knowledge.

II. Conclusion

In conclusion, the "Half-silvering Dimensions" theory holds immense potential to expand our understanding of the universe and unveil hidden realms of existence. While it presents challenges and raises ethical considerations, the positive implications are significant, offering exciting opportunities for scientific exploration, technological advancements, and even interdimensional communication. I urge you to embrace this theory, explore its possibilities, that may forever transform our perception of reality.

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 24 Issue 3 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed Interenational Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Mass Interaction Principle as a Foundational Framework for Quantum Mechanics

By Chu-Jun Gu

Abstract- This paper proposes mass interaction principle (MIP) as: the particles will be subjected to the random frictionless Brownian motion by the collision of space time particle (STP) ubiquitous in spacetime. The change in the amount of action of the particles during each collision is an integer multiple of the Planck constant h. The motion of particles under the action of STP is a Markov process. Under this principle, we infer that the statistical inertial mass of a particle is a statistical property that characterizes the difficulty of particle diffusion in spacetime. Within the framework of MIP, all the essences of quantum mechanics are derived, which proves that MIP is the origin of quantum mechanics. Due to the random collisions between STP and the matter particles, matter particles are able to behave exactly as required by the supervisor and shepherd for all microscopic behaviors of matter particles. More importantly, we solve a world class puzzle about the anomalous magnetic moment of muon in the latest experiment, and give a self-consistent explanation to the lifetime discrepancy of muon between standard model prediction and experiments at the same time. Last but not least, starting from MIP, we prove the principle of entropy increasing and clarify the physical root of entropy at absolute zero.

Keywords: mass interaction principle, special relativity, schrödinger equation, electromagnetism, photon, spin.

GJSFR-A Classification: LCC: QC174.12 .E96

MASSINTERACTIONPRINCIPLEASAFOUNDATIONALFRAMEWORKFORQUANTUMMECHANICS

Strictly as per the compliance and regulations of:

Mass Interaction Principle as a Foundational Framework for Quantum Mechanics

Chu-Jun Gu

Abstract- This paper proposes mass interaction principle (MIP) as: the particles will be subjected to the random frictionless Brownian motion by the collision of space time particle (STP) ubiquitous in spacetime. The change in the amount of action of the particles during each collision is an integer multiple of the Planck constant h. The motion of particles under the action of STP is a Markov process. Under this principle, we infer that the statistical inertial mass of a particle is a statistical property that characterizes the difficulty of particle diffusion in spacetime. Within the framework of MIP, all the essences of quantum mechanics are derived, which proves that MIP is the origin of quantum mechanics. Due to the random collisions between STP and the matter particles, matter particles are able to behave exactly as required by the supervisor and shepherd for all microscopic behaviors of matter particles. More importantly, we solve a world class puzzle about the anomalous magnetic moment of muon in the latest experiment, and give a self-consistent explanation to the lifetime discrepancy of muon between standard model prediction and experiments at the same time. Last but not least, starting from MIP, we prove the principle of entropy increasing and clarify the physical root of entropy at absolute zero. Within the framework of MIP, we comprehensively discussed the Copenhagen interpretation. It leads to an important conclusion that Copenhagen interpretation is unnecessary for the quantum mechanical system. We found that Maxwell's classical electromagnetic theory is applicable to the microscopic world not as previously thought. The key is that Brownian motion and classical electromagnetic theory must be combined together to completely solve the problem of electrons outside the nucleus not radiating electromagnetic waves.

Keywords: *mass interaction principle, special relativity, schrödinger equation, electromagnetism, photon, spin.*

I. Introduction

a) Spacetime Fluctuation, STP and MIP

We believe the energy fluctuations of spacetime are universal, which are defined as STP. In this picture, particles are classified into two groups: one is matter particles [1] which interact with STP, another one is massless particles which freely move in spacetime. Matter particles change their states by all the collisions with STP. The underlying property of mass is a statistical property emerging from random impacts in spacetime. Different particles have different effects of impact by STP, which can be defined as some kind of inertia property of particles. This property corresponds to mass dimension (Following we will prove it happens to be the inertial mass from Schrödinger's equation). Matter particles develop a Brownian motion due to random impacts from spacetime. We strongly suggest that all the probabilistic behaviours of quantum mechanics come from the Brownian motion, which is exactly the origin of quantum nature. In the framework of MIP, the photon represents itself as a Hopf link exicitation made of the 2+1-dim gauge field and its Hodge dual partner. On the other hand, under the MIP framework, photons not only exchange electromagnetic interactions, they also exchange spin information. It just explains that the annihilation condition of positive and negative electrons is not only the opposite of charge, but also the opposite of its spin. In modern physics, the spin and charge of matter particles are independent

Author: *Institute of Theoretical Physics, Grand Genius Group, Beijing, P. R. China.*
e-mail: cj_gu@grandgeniusgroup.com

quantum properties. However, the spin has a magnetic moment and indicates that the spin and electromagnetic interactions are related. Under the MIP framework, this apparent contradiction can be self-consistently explained.

We believe the quantum behaviours of matter particle come from spacetime fluctuation. The energy fluctuation of spacetime is quantised. We call the quantised energy as spacetime particle. It is a massless and spinless scalar particle. The exchange of energy between particle and STP is not strictly random, which leads to a unique Brownian-like motion. Once the time interval of impact is fixed, the exchange of energy has to be quantised, which indeed is the quantum nature of particles. Therefore, all quantum nature of particles is a faithful representation of spacetime quantised fluctuation.

Matter particles will perform random fluctuation motion in spacetime because of stochastic interactions between STP and matter particles, within which the energy exchange can not be achieved instaneously. For free matter particles, we define the product of exchanged characteristic energy and the corresponding time interval as the change of action in the collision process(For more details, please refer to Appendix A).

b) Inertia Mass is a Statistical Property

Until now, our knowledge of mass, a fundamental concept of physics, mainly comes from Newton's laws of motion especially the first and second laws. The definition of mass in physics is a basic property of particles. The amount of matter contained in object is called the mass of object. The mass is related to the inertial nature of the object's original motion state.

The first law states that in an inertial reference frame, an object either remains at rest or continues to move at a constant speed, unless acted upon by a force. However according to the MIP, free particle has to do Brownian-like motions in spacetime, which is a Markov process. The mass of particle, in order to be sensed by spacetime, has to be collided randomly by STP. Mass cannot be well defined within the interval of two consecutive random collisions. In other words, mass is not a constant property belonging to the particle itself, but a discrete statistical property depending on dynamical collisions of spacetime. We will derive from MIP straightforwardly that mass must be a statistical term which has its own means and fluctuations.

Moreover, we prove the uncertainty relation asserting a fundamental limit to the precision regarding mass and diffusion coefficient. This implies that both mass and diffusion coefficient of any particle state can not simultaneously be exactly measured. Newton's Second law states that in an inertial reference frame, the vector sum of the forces F on an object is equal to the mass m of that object multiplied by the acceleration of the object. This connects the concept of mass and inertia and in principle defines a fundamental approach to measure the mass of any particle experimentally. However, according to the MIP, forces on a particle are changed constantly by the random impact of STP. Therefore, we are no longer able to take constant mass for granted. In conclusion, we believe that mass as a statistical property is much more natural within the framework of modern science, which completely overrules Newton's concept of mass based on Mathematical Principles of Natural Philosophy first published in 1687.

[1] Matter particle means fermions with mass.

c) Realistic Interpretation of Quantum Mechanics

The main idea of Copenhagen interpretation is that the wave function does not have any real existence in addition to the abstract concept. In this article we do not deny the internal consistency of Copenhagen interpretation. We admit that Copenhagen′s quantum mechanics is a self-consistent theory. Einstein believed that for a complete physical theory, there must be such a requirement: a complete physical theory should include all of the physical reality, not merely its probable behaviour. From the materialistic point of view, the physical reality should be measured in principles , such as the position q and momentum p of particles. In the Copenhagen interpretation, the particle wave function $\Psi(q,t)$ or the momentum wave function $\Psi(p,t)$ is taken to be the only description of the physical system, which can not be called a complete physical theory, at most a phenomelogical effective theory. Therefore, in this paper, we propose a MIP where the coordinate and momentum of particles are objective reality irrespective of observations . With the postulation of MIP, quantum behaviour will emerge from a statistical description of spacetime random impacts on the experimental scale, including Schrödinger′s equation, Born rule, Heisenberg′s uncertainty principle and Feynman′s path integral formulation. Thus, we believe that non-relativistic quantum mechanics can be constructed under the MIP. Born rule and Heisenberg′s uncertainty relation are no longer fundamental within our framework.

d) Photon under the MIP framework

Within the framework of MIP, STP spread over spacetime, and its energy spectrum distribution is consistent with scalar particles. It can therefore be thought of as an excitation of a scalar field. The influence of material particles on its spacetime is local, so on the 2+1-dimensional time-space slice, the influence of material particles on spacetime can be regarded as a potential energy.

In modern quantum field theory, an important point is that microscopic energy can be nonconservative, and it can fluctuate to form pairs of virtual positive and negative particles. Within the framework of MIP, the fluctuation of spacetime energy is itself STP. The number of STP particles is not conserved locally, but globally, the energy of STP is conserved. So the picture of STP as a free particle is restored on a large scale. This just shows that STP has some local symmetry, which is broken at large scale. In essence, when the domain symmetry of the authority is $U(1)$, STP is the excitation of a complex scalar field.

On the other hand, the spacetime can be regarded as 2+1-dimensional around the spacetime in which the material particles are located. On this 2+1-dimensional spatiotemporal slice, STP is the excitation of the complex scalar field, which is accompanied by the excitation of the gauge field. The material particle produces a local non-perturbative potential energy in the surrounding space and time. The existence of this potential energy can cause the STP to spontaneously form a stable vortex solution. If the STP is not accompanied by a gauge field, then the vortex solution will cause the problem of energy divergence in the vortex center. The gauge field just eliminates the problem of local energy divergence.

The existence of a vortex solution also provides a possibility of duality, namely Hodge duality. The Hodge duality will extend the dynamics of the 2+1 dimensional gauge field to the 3+1 dimension. In the sense of Lagrangian, the 3+1-dimensional gauge field just describes the electromagnetic field theory. That is to say, the 3+1-dimensional equation of motion is Maxwell's equation. Therefore, we derive the classical electromagnetic theory from the vortex dynamics of STP.

In the MIP framework, the photon is essentially a topological excited state of two 2+1-dimensional gauge fields with their field strengths being Hodge's dual, and its topological configuration is a Hopf chain. Physically, photons transfer phase changes of material particles. Its equation of motion is the Maxwell equation.

On the other hand, the two topological circles of the photon, of which topological configuration Hopf link correspond to the topological subspace of the local spacetime. The Hopf links just represent the Lorentz representation of spin 1, which is a vector representation. Therefore, within the framework of MIP, the spin 1 of zero-mass photon is also self-consistently explained.

e) Radiation under the MIP framework

As a real object, electrons move locally in atoms and cannot maintain a state of linear and uniform motion, so they must have acceleration. Classical electromagnetic theory predicts that accelerated charged particles will radiate electromagnetic waves, which is in an obvious contradiction with the stability of atoms. Is the classical electromagnetic theory really invalid in the microscopic world? We gave a negative answer. Maxwell's electromagnetic theory still holds true in the microscopic world. Only by combining electromagnetic theory with Brownian motion, it can be proven that free electrons and electrons outside the nucleus do not radiate electromagnetic waves. In this chapter, we will prove this extremely important conclusion in detail, thereby establishing an objective reality picture of the microscopic world and a materialist interpretation of quantum mechanics.

f) Fremion spin under the MIP framework

Within the framework of MIP, a careful observation of properties near the singularity at the center of the STP vortex, drive us to a new perspective of particle spin. We noticed there are not only energy divergence at the singularity on the center of the STP vortex, there also exists a disorientation property for a direction vector. To describe the disorientation, we introduce the torsion based on the cotangent vielbein field. The torsion tensor actually drives the cobordism topological phase transition between STP vortices on tangent space and its dual normal space. By the cobordism topological phase transition, we combined vortices on the 2+1 dimensional tangent space and normal space into a 3+1 dimensional instanton. The cost of this cobordism topological phase transition, is to calculate the corresponding topological order. By cohomological theory, we calculated the incomplete angle due to the cobordism topological phase transition, which concludes that the incomplete angle is an integer times π,this angle contributes to the STP vortex around matter particle a factor $e^{iN\pi}$. When rotating the particle a circle, the factor changed the signature of the wave function. This inveals the origination of particle spin is a topological phase transtion between STP vortices around the matter particle. Within the framework of MIP, particle spin describes the topological order of this cobordism phase trantion of STP vortices.

g) Muon anomalous magnetic moment under the MIP framework

On April 7, 2021, FermiLab performs a new muon anomalous magnetic moment experiment. The experimental value differs from the theoretical value predicted by the Standard Model

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

with 4.2σ standard deviation. The probability of this deviation comes from statistical fluctuations is 1 in 40000, which implies possible physics beyond the Standard Model. The new massless scalar STP required by the MIP is a key step beyond the existing standard model. Introducing only one parameter, the interaction strength between STP and lepton, not only perfectly solves the world-class problem of the anomalous magnetic moment of muons in the latest experiment, but also explains the muon lifetime discrepancy between theory and experiment. It can be seen that this is a triumph for applications of MIP in modern particle physics.

Last and most importantly, we derived the generation for charged leptons. This is a completely new result and one can not derive this law in current quantum field theory framework. Within the MIP framework, by invoking the STP vortices, the generation is a direct inference.

h) Entropy under the MIP framework

We start from MIP and combine it with the mathematical properties of Markov process to prove the principle of entropy increasing in the non-interacting systems. It must be emphasized that this principle is still an empirical law in modern physics and cannot be proven from first principles, therefore our proof has a far-reaching significance. We can clearly see that the principle of entropy increasing comes from the statistical effect of random collisions by STP. The random collision of STP under MIP can naturally produce the principle of entropy increasing of material particles, which is one of the cornerstones in physics.

II. Mass Interaction Principle

a) Proposing the MIP

Particles moving in spacetime interact with STP. The generation of STP itself should be regarded as a microscopic random excitation of local spacetime energy. We can assume the following two self-consistent ideal STP models. First, the spacetime itself is discrete, and each of the smallest spacetime units can act on the particle to change the particle's motion . However this spacetime unit acts as a random force on the particles, the motion of the particles in spacetime under the action of STP will also be random. Secondly, the energy distribution of STP is Gaussian, therefore, when they were scattering with matter particle, the force is random.

Furthermore, we propose in each interaction between matter particle and STP, the exchanging action should be nh, with n integer and h the Planck constant. According to this, we can define the MIP accurately. Suppose STP begin to collide with matter particle at time t_1 and end it at at time t_2 to exchange energy E. Without the collision of STP, the action of particle at the same interval will be

$$S = \int_{t_1}^{t_2} E_0 dt \tag{2.1}$$

With the collision of STP, the action of particle at the same interval will be

$$S' = \int_{t_1}^{t_2} E(t) dt \tag{2.2}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Therefore the change of action in Definition 1 is

$$\delta S = S' - S = \int_{t_1}^{t_2} [E(t) - E_0]dt \equiv \int_{t_1}^{t_2} f(t)dt \tag{2.3}$$

By definition, integral function $f(t)$ is a monistic increasing function $f(t)$ with following property

$$f(t_1) = 0, f(t_2) = E \tag{2.4}$$

According to Mean value theorems for integrals, there exists one point t^* at the interval satisfying

$$\int_{t_1}^{t_2} f(t)dt = f(t^*)(t_2 - t_1) \tag{2.5}$$

Setting exchange of energy be $E^* = f(t^*)$ at this point, we have $0 < E^* < E$. So the exact formula of the change of action is

$$\delta S = E^* \delta t \tag{2.6}$$

where $\delta t \equiv t_2 - t_1$. Therefore we are sure that, it is this characteristic exchange energy E^* not the energy of STP itself corresponding to the change of action. With MIP $\delta S = nh$, it's impossible to interact instantaneously, since the exchange energy E^* will blow up.
In our MIP framework, there are no instant interactions between matter particle and STP, in other words, the interaction takes time to transfer the energy. If the scattering STP has an extremely low energy such that in Δt, the transfered action is less then h , we conclude that in Δt, the STP cannot collide the particle. We argue that such a collision is still in process, the particle as well as the STP are in a bound state, not a scattering state. This is similar to a completely inelastic collision in classic mechanics. While in such a process, the conservation of energy and momentum can not be satisfied simultaneously. Because of conservation of energy and momentum, the bound state actually is not a stable state. This observation leads to an important point: there exists a minimal energyE_{min} in Δt so that

$$E_{min} \Delta t = const. \tag{2.7}$$

In physics , the product of energy and time will have the dimension of action. It is natural to suggest such a constant with action dimension is the Planck constant, so we have

$$E_{min} \Delta t = nh, n \in Z. \tag{2.8}$$

At a certain moment, particle can be scattered by many STP with different momenta and energies. In Δt, we assume there are effectively N collisions. The state of the motion will depends on the net effect of the N times collision. This is a principle of superposition. We can use in total N vectors to superposite whole changes of the state of motion, which means if at time t the particle was at position $\vec{X}(t)$, with speed $\vec{V_0}$, then at the moment $t + \Delta t$, its position will be $\vec{x}(t + \Delta t) = \vec{X}(t) + \sum_{i=1}^{N} \Delta X_i$, and speed$\vec{V_0} + \sum_{i=1}^{N} \Delta \vec{V_i}$. This simple analysis tells us in Δt, the ultimate state of motion of the particle can be separated as N

different paths. This is the effect of separation of paths. While the weights of these paths, *aka* the probability distribution of universal diffusion, highly rely on the energy distribution of STP. Collisions by STP with different energies end up with different changes of the state of motion.

b) The Nature of Spacetime within the framework of MIP

At the beginning of the 20th century, the null result of the Michaelson-Morley experiment ended the ether theory. Within the framework of MIP, the concept of spacetime looks very similar to that of ether, but it is fundamentally different. To clarify this, let us first review the concept of ether. The ether is a gas medium filled in Newton's absolute static time and space. Its definition directly introduces a reference frame of God's perspective, which is Newton's static spacetime system. The earth and this frame of reference are relatively moving, so they will feel the ether wind blowing, which is the experimental basis of the Michaelson-Morley experiment. But spacetime is not a gaseous medium filled with absolute time and space. It is the fluctuation of time and space. From a large scale, the fluctuation of spacetime does not have significant effects. Spacetime seems to be smooth and differentiable, and the differential geometry theory of general relativity can effectively describe the physical properties of large-scale spacetime. However, on the microscopic scale, the fluctuation of spacetime indicates that spacetime itself does not have continuous property. There is no absolute static spacetime reference frame in the above discussion, so the STP within the framework of MIP is not etheric.

The null result of the Michaelson-Morley experiment actually promoted Einstein's most important hypothesis of the theory of relativity, which is the constant speed of light. In the theory of relativity, the constant speed of light is the only absolute assumption, and the relativity of all other speeds remains.

Within the framework of MIP, the energy fluctuation of spacetime forms STP. If you think of spacetime as a peaceful lake, then STP is the splash of water on the surface of the lake. When it falls on the surface of the lake, it will form ripples. Therefore, the emergence of STP is always accompanied by the spread of ripple. The propagation speed of ripple is the characteristic propagation speed in spacetime. Forming a STP means that fluctuation of spacetime will spread to a certain spatial distance within a certain period of time, so the spacetime around the STP is also changed. We now know that the smallest scale of time is the Planck scale, and the smallest scale of space is the Planck length. In the Planck time STP has to spread a Planck length of space, so the propagating speed of STP is the same as light speed.

From the spacetime view of MIP, any physical observable event in spacetime will inevitably accompany the fluctuation of spacetime energy, which will profoundly affect the spacetime after the event. Under such a view of spacetime, the current spacetime is actually the result of the joint influences of all events in the history.

c) Energy spectrum of STP

To consider the collision between STP and particle, it will be ambiguous if the energy spectrum of STP is not clear at first. In this subsection, we deal with this problem.

Let us consider a cubic with volume L^3, which we call a system. If there are in total N

systems in spacetime, we can classify the N systems by states. We label a state by j so that there are N_j systems with energy E_j. The total energy of the ensemble(collection of N systems) is denoted as $\mathcal{E}$, we have

$$N = \sum_j N_j \tag{2.9}$$

$$\mathcal{E} = \sum_j N_j E_j, \tag{2.10}$$

for constant $\mathcal{E}$ and N, the possible total number of states in whole spacetime will be $\Omega = \frac{N!}{\prod_j N_j!}$. Physical reality is required by the maximum of Ω. There is a distribution $\{N_j\}$ maximizing Ω, so that

$$\ln\Omega = N\ln N - N - \sum_j N_j \ln N_j + \sum_j N_j \cdots \tag{2.11}$$

the question is under constraints (2.9,2.10), how to maximize $\ln\Omega$. With the method of Lagrangian multiplier,

$$\frac{\partial \ln\Omega}{\partial N_j} - \lambda_1 \frac{\partial \sum_j N_j}{\partial N_j} - \lambda_2 \frac{\partial\left(\sum_j N_j E_j\right)}{\partial N_j} = 0 \tag{2.12}$$

we can derive

$$\begin{aligned} -\ln N_j - \lambda_1 - \lambda_2 E_j &= 1 \Rightarrow \\ N_j &= e^{-1-\lambda_1-\lambda_2 E_j} \end{aligned} \tag{2.13}$$

hence the probability of being at state j

$$P_j = \frac{N_j}{N} = \frac{e^{-\lambda_1-\lambda_2 E_j}}{\sum_j e^{-\lambda_1-\lambda_2 E_j}} = \frac{e^{-\lambda_2 E_j}}{\sum_j e^{-\lambda_2 E_j}} \equiv \frac{e^{-\lambda_2 E_j}}{\mathcal{Z}} \tag{2.14}$$

and the average energy of the ensemble

$$E = \frac{\mathcal{E}}{N} = \sum_j E_j P_j = -\frac{\partial}{\partial\lambda_2}\ln\mathcal{Z} \tag{2.15}$$

In L^3 , suppose there are $n_{\vec{p}} = 0, 1, 2, \cdots$ STP have momentum $\vec{p}$, for giving distribution $\{n_{\vec{p}}\}$, the energy in L^3 is

$$E = \sum_{\{n_{\vec{p}}\}} n_{\vec{p}} E_{\vec{p}} \tag{2.16}$$

with $E_{\vec{p}} = c|\vec{p}| = cp$. Here STP are massless as proposed. We have

$$\begin{aligned}\mathcal{Z} &= \sum_{\{n_{\vec{p}}\}} e^{-\lambda_2 E} = \prod_{\vec{p}} \left(1 + e^{-c\lambda_2 p} + e^{-2c\lambda_2 p} + \cdots\right) \\ &= \prod_{\vec{p}} \frac{1}{1 - e^{-c\lambda_2 p}} \end{aligned} \tag{2.17}$$

and the average energy of a system is

$$\begin{aligned} E &= -\frac{\partial}{\partial \lambda_2} \ln \mathcal{Z} = \frac{\partial}{\partial \lambda_2} \sum_{\vec{p}} \ln\left(1 - e^{-c\lambda_2 p}\right) \\ &= \sum_{\vec{p}} \frac{p e^{-c\lambda_2 p}}{1 - e^{-c\lambda_2 p}} = \sum_{\vec{p}} \frac{cp}{e^{c\lambda_2 p} - 1} \end{aligned} \tag{2.18}$$

when $L \to \infty$, summation becomes integration as follow

$$\sum_{\vec{p}} \to \frac{L^3}{8\pi^3} \int d^3\vec{p}$$

from which we see

$$E = \frac{L^3}{2\pi^2} \int dp \frac{p^3}{e^{c\lambda_2 p} - 1} = \frac{\pi^2 L^3}{30\lambda_2^4} \tag{2.19}$$

so the density of STP will be

$$\epsilon_{ST} = \frac{\pi^2}{30\lambda_2^4} \tag{2.20}$$

Recover c and $\hbar$ in above equation, we obtain

$$\epsilon_{ST} = \frac{\pi^2}{30c^3\hbar^3\lambda_2^4}. \tag{2.21}$$

Now consider the physical meaning of λ_2, which determines the constraint that represents energy distribution of STP. While the multiplier λ_1 which determines the constraint represents the number distribution of STP has no affects on the dynamics of STP. This means we can classify STP arbitrarily, except to satisfy the total energy constraint. For example, the action of particle changed $kh, k \in \mathbb{Z}$ in a certain collision by STP. In physics we can not distinct one STP collision or many STP collision, since neither from energy spectrum of STP nor from the change of status of the particle can distinct them. From dimensional analysis and MIP, we have

$$\lambda_2 = \frac{g}{E_{ST}} \tag{2.22}$$

where g is a dimensionless coupling constant, and E_{ST} is the characteristic energy of STP. In the limit of extreme relativity, the colliding of STP can not be seen as perturbations, but strong disturbances.

III. Random Motion and Spacetime Diffusion Coefficient

Let m_{ST} be the statistical mass of the particle . We will prove the spacetime interaction coefficient of a m_{ST} mass particle will be universally given as

$$\Re = \frac{h}{2m_{ST}}. \tag{3.1}$$

Within the framework of random motion[1], or Wiener process in mathematics [2], this spacetime induced random motion is equivalent to the Markov process, moreover, the spacetime interaction coefficient is nothing but the diffusion coeffient [3]. In this section, we will start our journey from propability theory of random motion[3, 4], and then give a concrete proof that for the random motion induced by MIP, the spacetime interaction coefficient is given exactly by (3.1). The last two subsections discussed two spacetime models in order to investigate the origin of the spacetime interaction coefficient. We have obtained the coefficient reading as $\Re = \frac{w\ell}{2}$, where w is the average speed of the particle and ℓ the mean free path.

a) Langevin Equation

The space-time background can be seen as a fluctuation environment, and the particles move in this fluctuation environment. This is a Markov process. The position of the particle $\vec{q}$ is a random quantity. From a strict mathematical point of view, it can be decomposed into a super random part and a superimposable function

$$\vec{q}(t) = \vec{q}_0(t) + \vec{\omega}(t) \tag{3.2}$$

where $\vec{q}_0(t)$ is the differential part of position and $\vec{\omega}(t)$ represents random motions of particles. The whole motion of particle can be described by Langevin equation as

$$\frac{\delta q_i(t)}{\delta t} = \frac{dq_{0,i}(t)}{dt} + \frac{\delta \omega_i(t)}{\delta t} = U_i(\mathbf{q}(t)) + \nu_i(t) \tag{3.3}$$

In spacetime, particles are subjected to the impact of STP. But if some of the impact is relatively weak, then the change of the state of motion can only be regarded as a perturbation. Under perturbation, the velocity of the particles changes which can be seen as smoothly and continuously. The non-perturbative impacts of STP on the particles instantaneously change the motion state of the particles, leading to the completely random motion. Each impact should be treated as a sum of a differential impact and a random impact. A microscopic impact does not change the classic trajectory of the particle, but it will cause the trajectory to be superimposed on the motion of an envelope. This is precisely the "differentiable velocity function" $\mathbf{U}(\mathbf{q}(t))$ expressed by the first term in the three velocities decomposition of the Langevin's equation. Therefore, the true velocity of the particle $\mathbf{V}(t)$ should contain three contributions, which is

$$\mathbf{V}(t) = \mathbf{v}(t) + \mathbf{u}(\mathbf{q}(t)) + \vec{\nu}(t) \tag{3.4}$$

Where $\mathbf{v}(t)$ is the classic statistical velocity, $\mathbf{u}(\mathbf{q}(t))$ is the quantum envelope velocity of the particle, and $\vec{\nu}(t)$ is the diffusion velocity representing random motion. $\mathbf{U}(\mathbf{q}(t))$ denotes the union of the first and the second term in eq.(3.4)

$$\mathbf{U}(\mathbf{q}(t)) = \mathbf{v}(t) + \mathbf{u}(\mathbf{q}(t)) \tag{3.5}$$

For a Markov process, the average contribution of white noise vanishes. However, because of its Gaussian nature, its variation is not zero. We have

$$\langle \nu_i \rangle_\nu = 0, \;\; \langle \nu_i(t)\nu_j(t') \rangle_\nu = \Omega \delta_{i,j} \delta(t-t'), \;\; t \geq t' \tag{3.6}$$

here the $\delta_{i,j}$ in the later equation can be obtained from the spacetime homogeneous property, while $\delta(t-t')$ is determined from the Markov property. For a Markov process, only conditions at the very moment determine the dynamics of the system, and all information from future or past are irrelevant. We can write down the basic correlation function by introducing a probability measure $[d\rho(\nu)]$,which is given as

$$[d\rho(\nu)] := \left(\sqrt{\frac{1}{2\pi\Omega\delta(t-t')}} \right)^D [d\nu] \exp\left(-\frac{1}{2\Omega} \int dt \sum_i \nu_i^2 \right) \tag{3.7}$$

It is easy to see that

$$\nu_i(t)\rangle_\nu \equiv \int \nu_i(t)[d\rho(\nu)] \;\; = \;\; 0 \tag{3.8}$$

$$\nu_i(t)\nu_j(t')\rangle_\nu \equiv \nu_i(t)\nu_j(t')[d\rho[\nu]] \;\; = \;\; \Omega\delta_{i,j}\delta(t-t') \tag{3.9}$$

Here Ω describes the strength of spacetime interaction on the particle. Notice $\delta(t-t')$ has the inverse dimension of time t , as

$$\int_0^\infty \delta(t-t')dt = 1.$$

However, from the definition of measure (3.7), we can see, ν_i have the unit of m/s, so Ω will have the unit of m^2/s. From previous analysis, each collision leads to a change of an action h. h has the unit of angular momentum, $kg \cdot m^2/s$. From this we can define a quantity with mass unit, it is

$$m_{ST} \equiv \frac{h}{\Omega}. \tag{3.10}$$

The mass m_{ST} has the meaning such that it is the mass collided by STP and is a statistical property. Accordingly, the collision parameter $\Omega = \frac{h}{m_{ST}}$ reflects a physical realistic viewpoint: an object in our real nature, the larger its mass means the smaller its quantum effect.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Langevin equation generates a timedependent probability such that

$$\mathbf{P}[\mathbf{q},t;\ \mathbf{q}',t'] = \langle\prod_{i=1}^{D}\delta[q_i(t)-q_i'(t')]\rangle_\nu,\ t\geq t' \tag{3.11}$$

which means for an operator $\mathcal{O}[\mathbf{q}]$, its average value at time t will be:

$$\langle\mathcal{O}[\mathbf{q}(t)]\rangle_\nu \equiv \int \mathbf{P}[\mathbf{q},t;\ \mathbf{q}',t']\mathcal{O}[\mathbf{q}]d\mathbf{q} \tag{3.12}$$

Using the probability distribution (3.11), one can immediately verify equation (3.12). Actually, the distribution (3.11) can be seen as an evolution process, which says

$$\mathbf{P}[\mathbf{q},t;\ \mathbf{q}',t'] = \iint q(t)e^{-(t-t')H(p,q)}q'(t')d^Dp \tag{3.13}$$

here the evolution Hamiltonian is the famous Fokk-Planck Hamiltonian, as we will derive its formalism in next subsection.

b) Fokker-Planck Equation

Given the Langevin equation (3.3), we can derive the corresponding Fokk-Planck equation, as well as the Fokk-Planck Hamiltonian [3].

We consider the time segment from t to $t+\epsilon,\ \epsilon\to 0$, and have the Langevin equation as:

$$q_i(t+\epsilon)-q_i(t) = \epsilon U_i(\mathbf{q}(t)) + \int_t^{t+\epsilon}\nu_i(\tau)d\tau + O(\epsilon^2) \tag{3.14}$$

its related propability distribution is

$$\mathbf{P}[\mathbf{q},t+\epsilon;\ \mathbf{q}',t] = \langle\delta(\mathbf{q}-\mathbf{q}(t+\epsilon))\rangle_\nu \tag{3.15}$$

According MIP, everytime the STP collided with the particle, the action of particle will change $nh,\ \ n\in\mathbb{Z}$. To obtain the Fokk-Planck equation, we define following discreterization

$$\bar{\nu_i} \equiv \frac{1}{\sqrt{\epsilon}}\int_t^{t+\epsilon}\nu_i(\tau)d\tau \tag{3.16}$$

so that the discrete Langevin equation is

$$q_i(t+\epsilon)-q_i(t) = -\frac{1}{2}\epsilon f_i(\mathbf{q}(t)) + \sqrt{\epsilon}\bar{\nu_i} + O(\epsilon^2) \tag{3.17}$$

Notice here the time has been discreterized as

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

$$(t-t')/\epsilon \in \mathbb{Z}^{+}.$$

Now the Gaussian distribution and the property of Markov progcess determins the average value of discrete white noises ν_i, and we have

$$\langle \bar{\nu}_i \rangle_\nu = 0,\ \langle \bar{\nu}_i(t)\bar{\nu}_j(t')\rangle_\nu = \frac{\hbar}{m_{ST}}\delta_{i,j}\delta_{t,t'} \tag{3.18}$$

When $\epsilon \to 0$, the Fourier transformation of the probability distribution (3.15) is

$$\begin{aligned}
\tilde{\mathbf{P}}[\mathbf{p},t;\ \mathbf{q}',t']|_{t=t'+\epsilon} &= \int e^{-i\mathbf{p}\cdot\mathbf{q}}\mathbf{P}[\mathbf{q},t;\mathbf{q}',t\text{'}]d^D\mathbf{q}|_{t=t'+\epsilon} \\
&= \langle e^{-i\mathbf{p}\cdot\mathbf{q}'(\mathbf{t}-\epsilon)}\rangle_\nu \\
&= \langle e^{-i\mathbf{p}\cdot(\mathbf{q}'(\mathbf{t})-\epsilon\frac{\delta\mathbf{q}'(\mathbf{t})}{\delta\mathbf{t}}-\mathbf{O}(\epsilon^2))}\rangle_\nu \\
&= \langle \exp(-i\mathbf{p}\cdot(\mathbf{q}'(\mathbf{t})-\epsilon\mathbf{U}(\mathbf{q}')))\rangle_\nu \\
&\quad \times\left\langle \exp\left[+i\mathbf{p}\,\boldsymbol{.}\int_{t-\epsilon}^{t}\nu(\tau)d\tau\right]\right\rangle_\nu \times\left\langle \exp\left(O(\epsilon^2)\right)\right\rangle_\nu \\
&= \exp\left[-i\mathbf{p}\,\boldsymbol{.}\,(\mathbf{q}'-\epsilon\mathbf{U}(\mathbf{q}'))\right] \\
&\quad \times\left\langle \exp\left[+i\mathbf{p}\,\boldsymbol{.}\int_{t-\epsilon}^{t}\nu(\tau)d\tau\right]\right\rangle_\nu
\end{aligned} \tag{3.19}$$

Notice that the last average value can be evaluated out by Gaussian integration, which reads,

$$\begin{aligned}
&\left(\sqrt{\frac{h}{2\pi}}\right)^D \int[d\nu]\exp\left(-\frac{m_{ST}}{2h}\int dt\sum_i^D \nu_i^2\right)\exp\left[+i\mathbf{p}\,\boldsymbol{.}\int_{t-\epsilon}^{t}\nu(\tau)d\tau\right] \\
&= \left(\sqrt{\frac{h}{2\pi}}\right)^D \int[d\nu]\exp\left(-\frac{m_{ST}}{2h}\int dt\sum_i \nu_i^2 + i\mathbf{p}\,\boldsymbol{.}\int_{t-\epsilon}^{t}\nu(\tau)d\tau\right) \\
&= \left(\sqrt{\frac{h}{2\pi}}\right)^D \int[d\nu]\exp\left(-\frac{m_{ST}}{2h}\int dt\sum_i \nu_i^2 + i\sqrt{\epsilon}\mathbf{p}\,\boldsymbol{.}\,\bar{\nu}\right) \\
&\quad \times\exp\left(-\epsilon\frac{h}{2m_{ST}}\mathbf{p}\,\boldsymbol{.}\,\mathbf{p}+\epsilon\frac{h}{2m_{ST}}\mathbf{p}\,\boldsymbol{.}\,\mathbf{p}\right) \\
&= \left(\sqrt{\frac{h}{2\pi}}\right)^D \int[d^D\left(-\nu_i-\frac{ih}{2m_{ST}}\sqrt{\epsilon}p_i\right)]
\end{aligned}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

$$\times \exp\left(-\frac{m_{ST}}{2h}\int dt \sum_{i=1}^{D}\left(\nu_i + \sqrt{\epsilon}\frac{ih}{2m_{ST}}p_i\right)^2 - \epsilon\frac{h}{2m_{ST}}\mathbf{p}\cdot\mathbf{p}\right)$$

$$= \exp\left(-\epsilon h\mathbf{p}\cdot\mathbf{p}/(2m_{ST})\right) \qquad (3.20)$$

here we obtain the probability distribution under Fourier transformation ,

$$\tilde{\mathbf{P}}[\mathbf{p}, t+\epsilon;\ \mathbf{q}', t] = e^{-\epsilon h/2m_{ST}\mathbf{p}\cdot\mathbf{p} + i\epsilon\mathbf{p}.f(\mathbf{q}')/2 - i\mathbf{p}\cdot\mathbf{q}'} \qquad (3.21)$$

for $\epsilon \to 0$, expanding (3.21) will end up with

$$\tilde{\mathbf{P}}[\mathbf{p}, t+\epsilon;\ \mathbf{q}', t] = e^{-i\mathbf{p}\cdot\mathbf{q}'}(1 - \epsilon H_{FP}(\mathbf{p}, \mathbf{q}') + O(\epsilon^2)).$$

Here we obtained the Fokk-Planck Hamiltonian

$$H_{FP}(\mathbf{p},\mathbf{q}) = -\frac{h}{2m_{ST}}\mathbf{p}\cdot\mathbf{p} - i\mathbf{p}\cdot f(\mathbf{q})/2 \qquad (3.22)$$

From which we can read off the diffusion coefficient induced by collisions between STP and the particle, is exactly $\Re = h/2m_{ST}$. Later we will see in deriving the Schrödinger equation of free particle in spacetime, the spacetime mass $m_{ST} = 2\pi m$ will be identified as the inertial mass, in the framework of non-relativistic quantum mechanics.

c) *From spacetime scattering to spacetime diffusion coefficient*

i. *From spacetime scattering to spacetime diffusion coefficient*

Beginning with MIP, we want to investigate the origin of spacetime interaction coefficient. Within the framework of discrete spacetime, spacetime diffusion coefficient $\Re = \frac{h}{2m_{ST}}$ should be derived in terms of parameters of discrete spacetime. Let us consider the simplest discrete model (see Fig.1), where the length union of discrete space is ℓ. $P(j,t)$ is the probability of a particle at lattice site j at time t.

Because of the discrete nature of the space, all jumpings can only happen between nearest pair of positions. Given the rate of jumping between the nearest neighbour ζ and the isotropy

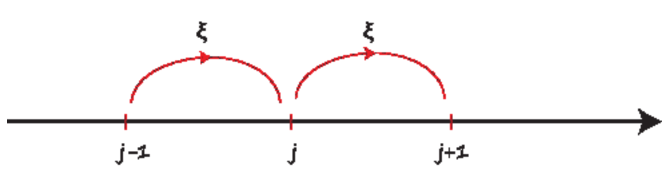


Figure 1: Random jumping model on one dimensional lattice

of frictionless space, the evolution of probability should be

$$\partial_t P(j,t) = \zeta(\frac{1}{2}P(j-1,t) + \frac{1}{2}P(j+1,t) - P(j,t)) \qquad (3.23)$$

the first two terms of RHS of (3.23) describe the fact that jumping forward and backward from neighbors $j-1$ and $j+1$ positions respectively, have the same probability, which is 1/2, the third term remarks the probability from j position to neighbors. Introducing the fundamental spacing of the lattice ℓ, the eq.(3.23) goes to

$$\partial_t P(j,t) = \frac{\zeta\ell^2}{2}\left(\frac{\frac{P(j+1,t)-P(j,t)}{\ell} - \frac{P(j,t)-P(j-1,t)}{\ell}}{\ell}\right) \tag{3.24}$$

In the continum limit of spacetime, which says $\ell \to 0$, and $\zeta \to \infty$, but keeping the quantity $\zeta\ell^2$ unchanged, the probability $P(j,t)$ now becomes the probability density $\rho(x,t)$, and the RHS of (3.23) becomes the definition of second derivative. Thus we have

$$\partial_t \rho(x,t) = \frac{\zeta\ell^2}{2}\partial_x^2 \rho(x,t). \tag{3.25}$$

It is straightforward to generalise above equation to three dimension case, we have,

$$\partial_t \rho(\vec{r},t) = \frac{\zeta\ell^2}{2}\nabla^2 \rho(\vec{r},t) \tag{3.26}$$

Comparing with diffusion equation in Einstein's paper[6]

$$\partial_t \rho(\vec{r},t) = \Re\nabla^2 \rho(\vec{r},t) \tag{3.27}$$

the microscopic origin of spacetime diffusion coefficient will be

$$\Re = \frac{\zeta\ell^2}{2} \tag{3.28}$$

Furthermore, we can also discrete time with union $\tau = \frac{\ell}{w}$, where w is the average speed of particle. With $\zeta = \frac{1}{\tau}$, we obtain

$$\Re = \frac{w\ell}{2} \tag{3.29}$$

Combining the microscopic structure of discrete spacetime with the MIP, we have

$$\Re = \frac{w\ell}{2} = \frac{h}{2m_{ST}} \tag{3.30}$$

ii. *From Spacetime Scattering to the Spacetime Diffusion Coefficient*

Particles will be scattered randomly from the STP with the speed of light, which leads to the probability distribution of speed $f(\vec{v})$, the number of partials within $v \to v + dv$ is

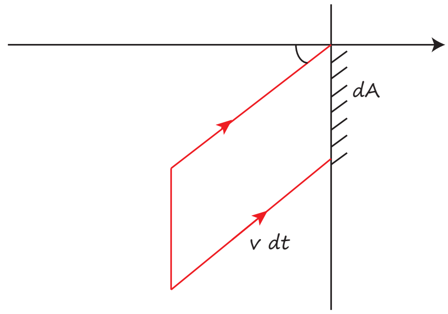


Figure 2: Probability distribution of spacetime scattering

$f(v)d^3\vec{v}$. Therefore, all the particles cross the section area dA during time dt will be inside the cylinder (see Fig.2).

The volume of this cylinder is

$$V = vdt\cos\theta dA \tag{3.31}$$

in which the number of particles is

$$N = f(\vec{v})d^3\vec{v}vdt\cos\theta dA \tag{3.32}$$

Because of the isotropy of space, we have $f(\vec{v}) = f(v)$. From left to right, the number of particle cross the unit area per unit time is

$$\begin{aligned}\Phi &= \int_{v_z>0} \frac{N}{dAdt} \\ &= \int_0^{\frac{\pi}{2}} d\theta\cos\theta\sin\theta \int_0^{2\pi} d\phi \int_0^{+\infty} f(v)v^3 dv \\ &= \pi \int_0^{+\infty} f(v)v^3 dv \end{aligned} \tag{3.33}$$

where $v_z > 0$ means $0 < \theta < \frac{\pi}{2}$. The average speed reads

$$w = \frac{\int_0^{+\infty} f(v)vd^3v}{\int_0^{+\infty} f(v)d^3v} = \frac{4\pi}{\rho}\int_0^{+\infty} f(v)v^3 dv \tag{3.34}$$

where the density of particle number is $\rho = \int_0^{+\infty} f(v)d^3v$. Correspondingly, the number of particle cross the unit area per unit time will be

$$\Phi = \frac{1}{4}\rho w \tag{3.35}$$

Let mean free path of particles be ℓ, i.e. the average distance traveled by the particle between successive impacts from spacetime. The net flux J_z through the z plane will be (see Fig.3)

$$J_z = \frac{1}{4}\rho(z-\ell)w - \frac{1}{4}\rho(z+\ell)w = -\frac{1}{2}\ell w\partial_z\rho \tag{3.36}$$

With the equation of continuity

$$\partial_t\rho + \nabla\cdot\vec{J} = 0 \tag{3.37}$$

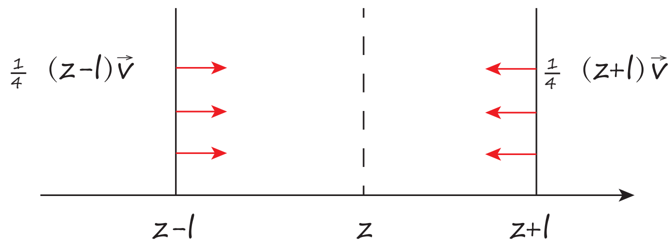


Figure 3: Mean free path and scattering fux

and the isotropy of space, we have

$$\partial_t\rho = \frac{1}{2}\ell w\nabla^2\rho \tag{3.38}$$

Combining the kinetics of spacetime scattering with quantum nature induced by STP, we obtain

$$\Re = \frac{w\ell}{2} = \frac{h}{2m_{ST}} \tag{3.39}$$

which is consistent with eq.(3.30).

d) Statistical mass of fundamental particles

Let's consider the electron at first. The mass of an electron is $m_e = 9.104\times10^{-31}kg$. So its static energy is

$$E_e = m_e c^2 = 9.104\times10^{-31}\times9\times10^{18}J = 8.1936\times10^{-12}J$$

This energy, according to MIP, comes from "effective" collisions between STP and the electron. In our MIP theory, the electron is not a point-like particle. It is finite size, statistically. Because of symmetry, its shape is a ball with a sphere boundary. The effective collisions are considered as the number of STP which coming into and going out cross the sphere. Assume every effective collision gives energy, which numerically equals to Planck constant. Hence the times of effective collisons (TEC) can be calculated as follow

$$N_e = E_e/h = 1.2347\times10^{20}[s^{-1}]$$

The statistical mass of electron can be written in form of TEC

$$m_e = \frac{h}{c^2} N_e \tag{3.40}$$

The ratio of mass and TEC is

$$k_{st} \equiv \frac{h}{c^2} = 7.37 \times 10^{-51} kg \cdot s \tag{3.41}$$

It has the unit of $[mass] \cdot [time]$. The fluctuation of the density of STP, around the electron, denoted as $\Delta\rho^e_{st}$, can be written as

$$\Delta\rho^e_{st} \equiv \rho^e - \rho_0 = \frac{m_e c^2}{\frac{4}{3}\pi r^3 h} \tag{3.42}$$

For proton, it is easy to calculate exactly the same as the electron, we have

$$N_p = \frac{m_p}{k_{st}} = 1.6726 \times 10^{-27} / 7.37 \times 10^{-51} \simeq 2.227 \times 10^{23} [s^{-1}] \tag{3.43}$$

The radius of proton is

$$r_p \simeq 8.735 \times 10^{-16} m \tag{3.44}$$

from which we obtain the mean free path of a proton in the STP sea around it.

$$l_{st} = \sqrt[3]{\frac{4}{3}\pi r_p^3 / N_p} \simeq 2.3 \times 10^{-23} m$$

e) *Momentum and energy within the framework of MIP*

The time scale of physics spans many orders of magnitude. Cosmology studies the age of the universe at about 4×10^{17} seconds. Newtonian mechanics studies the low-velocity motion of macroscopic objects, and the time scale is usually on the order of seconds. The basic system of quantum mechanics is a hydrogen atom. When the electrons outside the hydrogen nucleus are in the ground state, the electrons move around the nucleus for about 1.5×10^{-15} seconds. The first excited state of the hydrogen atom transitions to the ground state emitting light with a wavelength of 121 nm, corresponding to a time period of 4×10^{-16} seconds. Modern physics believes that considering the principles of general relativity, special relativity and quantum mechanics, the smallest physical time scale is Planck time about 5×10^{-44} seconds, which is the smallest measurable time interval. According to academic consensus today, any changes during this time interval cannot be measured or detected.

Under the MIP framework, the average number of STP hitting electrons within one second is 10^{20}. That is to say, the theory derived from MIP in this paper has a typical time scale of 10^{-20} seconds. For electron, this time scale is 10,000 times shorter than quantum mechanics[2]. Therefore, energy conservation and momentum conservation in quantum mechanics are not constant conservation laws, but statistical average conservation under the MIP framework. The momentum and energy we define below are the results of statistically averaging the random effects of STP.

In the time interval of 10^{-20} seconds, we call the momentum of particle [3] as instant momentum. According to MIP, instant momentum is defined as

$$\vec{P}_i = m_i \vec{V} \tag{3.45}$$

Where m_i is the mass of the particles in the time interval of 10^{-20}seconds, which we call as instant mass. $\vec{V}$ is the true velocity of the particle

$$\vec{V} = \vec{u} + \vec{v} + \vec{\nu} \tag{3.46}$$

Similarly, we define the instant kinetic energy of the particle as

$$E_i = \frac{1}{2} m_i V^2 \tag{3.47}$$

The mass observed in modern physical experiments is the statistical mass of the particles, which is the inertial property at intervals greater than $\times 10^{-16}$ seconds. The momentum observed in modern physical experiments is the momentum predicted by quantum mechanics. Quantum mechanical momentum is the statistical average of instant momentum, which we call statistical momentum:

$$\vec{P}_s = <\vec{P}_i> = \frac{M_{st}}{2\pi} < \vec{v} + \vec{u} > \tag{3.48}$$

From this we relate the instant momentum at small time scales to the quantum mechanical momentum at large time scales. There is an important observation which we have proved in Chapter 5. The classical statistical velocity of any stationary state (the ground state is the lowest energy stationary state) is $\vec{v} = 0$, and the quantum envelop velocity of the ground state electrons of hydrogen atoms is

$$\vec{u} = -c\alpha\hat{r} \tag{3.49}$$

Where α is the Fine structure constant. Comparing the results of quantum mechanics: the momentum of the ground state electrons of a hydrogen atom must be zero, satisfying the isotropic wave function. Subtlely, the quantum envelope velocity does not contribute to the momentum of the ground state electrons because isotropic offsets each other by $<\vec{u}>=0$. Because quantum mechanics is the combined result of statistical averaging three velocities and instant mass on large time scales, $\vec{P}_s$ is consistent with the momentum calculated by quantum mechanics.

[2]In the field of particle physics, short lifetime such as the Higgs boson is about 1.5×10^{-22} seconds. For the Higgs boson, the average number of STP hitting a Higgs particle in a second is 10^{25} times. Its typical time scale is a thousand times smaller than quantum field theory.

[3]In the discussion below, the particles are all specific to electrons and represent the particles of matter.

The kinetic energy observed in modern physical experiments is the kinetic energy predicted by quantum mechanics theory. Quantum mechanical kinetic energy is the statistical average of instant kinetic energy, which we call statistical kinetic energy.

$$E_s =< E_i >= \frac{M_{st}}{4\pi} < V^2 > \tag{3.50}$$

The quantum envelop velocity contributes to the kinetic energy of the ground state electrons (always positive so cannot cancel out). Therefore, the energy of the ground state electron has two parts (the classical statistical velocity is always 0, and does not contribute to the ground state kinetic energy):

ground state energy = quantum envelop energy + coulomb potential

The calculated result is exactly -13.6 ev, which is also consistent with the energy calculated by quantum mechanics. The quantum envelop kinetic energy is defined as

$$E_e = \frac{1}{4\pi} M_{st} u^2 \tag{3.51}$$

Substituting the value of the electron energy of the ground state of a hydrogen atom

$$E = \frac{M_{st}}{4\pi} < (c\alpha)^2 > + < -\frac{e^2}{4\pi\epsilon_0} a >= -13.6ev \tag{3.52}$$

Where a is the Bohr radius of the hydrogen atom and ϵ_0 is the vacuum permittivity. Thus, we obtain the definitions of momentum and kinetic energy that are consistent with quantum mechanics.

More generally, the equivalence between statistical momentum and quantum mechanical momentum in any quantum state are proved as follows. According to the Ehrenfest theorem of quantum mechanics, the average value of particle positions evolves with time as

$$\frac{d}{dt}\langle \vec{x} \rangle = \frac{1}{i\hbar}\langle [\vec{x},\ H] \rangle = \frac{1}{i2m\hbar}\langle [\vec{x},\ p^2] \rangle = \frac{1}{i2m\hbar}\langle \vec{x}pp - pp\vec{x} \rangle \tag{3.53}$$

Combining with $\vec{x}pp - pp\vec{x} = i2\hbar\vec{p}$, we have

$$\frac{d}{dt}\langle \vec{x} \rangle = \frac{1}{m}\langle \vec{p} \rangle \tag{3.54}$$

This is a very important result, indicating how the momentum average of quantum mechanics is related to the mean value of the coordinates. In the MIP framework, the derivative of coordinates versus time is defined as

$$\frac{d}{dt}\vec{x} = \vec{u} + \vec{v} \tag{3.55}$$

Once two sides of the equation are averaged, the momentum average of quantum mechanics corresponds to the statistical momentum of the MIP as

$$\vec{P}_s =< \vec{P}_i >= \frac{M_{st}}{2\pi} < \vec{v} + \vec{u} > \tag{3.56}$$

which proves that the microscopic theoretical basis of quantum mechanics is exactly MIP.

V. Mass-Diffusion Uncertainty Relation

We now consider the motion status of particle under impacts of STP collisions. The most important proposition of Copenhagen interperitation of quantum mechanics is the wave-particle duality. This allows one using the superposition rule of plane waves to describe the state of a particle. The kernel of the wave transformation from frequency space to time space will be the factor $\exp(ipx/\hbar)$. In fact it introduces the quantized operator formalism $\vec{p} = -i\hbar\vec{\nabla}$. Because of the duality, physical quantities of the particle can also be derived from wave, which implies some quantities can be described in phase space as eigenvalues of special operators. However, under the framework of MIP, we need to emphrase again that the wave-like property of the particle is an emergent property due to collision of STP, therefore it is not intrinsic. We can not borrow the quantization hypothesis directly. We consider the action of the particle

$$\begin{aligned} &S[\phi(t,x), \partial\phi(t,x), \bar{\nu}(t,x)] \\ &\qquad = S_0[\phi(t,x), \partial\phi(t,x)] + \sum_{I=1}^{\infty} S_I[\bar{\nu}(t,x)] \end{aligned} \tag{4.1}$$

where $\phi(t,x)$ describing the classical trajectory of the particle, and S_0 is the related classical action. $S_I[\bar{\nu}(t,x)]$ is the contribution of $I-th$ collision between STP and the particle. It does not depend on the classical trajectory at all, which only depends on the fluctuation of STP. The MIP said this term should contribute integer number of h , that is $S_I = nh$.

The partition function of the particle now is

$$Z = \int [d\phi(t,x)] \exp(-\frac{i}{\hbar} S[\phi(t,x), \partial\phi(t,x), \bar{\nu}(t,x)]) \tag{4.2}$$

hence

$$\exp\left(-\frac{i}{\hbar} S_I[\bar{\nu}]\right) = \exp\left(-\frac{i}{\hbar} nh\right) = e^{-i2\pi n} = 1 \tag{4.3}$$

from which we see the introducing of MIP does not change the classical partition function, therefore physical quantity derived from classical action will not be affected.

a) *Mass-Diffusion Uncertainty*

We have claimed and proven that particle mass is a statistical property describing the diffusion ability of the particle in spacetime, ,which shows that mass and diffusion coefficient are indeed statistical properties, under continuous interaction of STP. However, MIP itself describes a special Markov process, which possesses the intrinsic characteristic property of being quantized.

Firstly, we will proof that within framework of MIP, the particle mass and the diffusion coeffient in spacetime are not only statistical conjuation to each other, but also satisfying the minimum uncertainty relation:

$$\Delta m \Delta \Re = h/2 \tag{4.4}$$

b) Instantaneous statistical inertia mass

In this article, mass reflects the statistical propterty of the motion of matter particle, which is drived by collisions of STPs with the particle. As a statistical physical quantity, its instantaneous value does not have an explicit meaning in physics. We do not know how to measure the collision of a single collision between one STP and the particle exactly. In the other way, when we consider the relation between collision and the spectrum of STPs, we had already proven the number of STPs can not be determinate accurately. Hence even for a single collision between STP and the particle, the mass of the particle is also a statistical property. With this point of view, the statistical mass can be defined instanteously. In Minkowski spacetime, the distribution of STPs is uniform and isotropic. The instantaneous mass of matter particle will be changed according to the speed of particle. Though the instantaneous mass of particle $\hat{m}$, varying every moment, when taking the mean of speeds of the particle, will regress to the statistical inertia mass m_{ST}.[4]

Because the exchanged action relating to every single collision is not the same, neither the energy of the STP in this collision. The time interval that accomplishing the exchanging of action, is also different in every collision. We know, as a reflection of the collision between STP and matter particle, the motion of particle will deviate from its classical velocity. The noise part $\vec{\nu}$ describes the deviation cause by the collision between STP and the particle. The bigger the noise is, the smaller the statistical inertia mass m_{ST} is. In another way, a bigger deviation means the particle can diffuse in spacetime easier, thus it corresponds to a bigger spacetime diffusion coefficient $\Re$. In the moment of measurement, because of the existence of noise, the instantaneous mass of the particle will not be exact as m_{ST}. We know

$$\Delta m = \hat{m} - m_{ST}$$

The instantaneous mass corresponds to every measurement does not have any real physical meaning. The standard deviation of many times of measurement results is what we care about, it is

$$\sigma(m) = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\hat{m}_i - m_{ST})^2} \tag{4.5}$$

[4]It possible that collisions of STP give matter particles the statistical property of mass, while the Higgs particle produces the average mass of matter particles.

With the same reason, we only care about the standard deviation of spacetime diffusion coefficients of every measurement

$$\sigma(\Re) = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\hat{\Re}_i - \Re\right)^2} \tag{4.6}$$

The relative difference of this two statistical quantity can be represented as the covariance, as

$$cov(m,\Re) = \frac{\sum_{i=1}^{N}\left(\hat{m}_i - m_{ST}\right)\left(\hat{\Re}_i - \Re\right)}{N\sigma(m)\sigma(\Re)} \tag{4.7}$$

Since the noise of STP is a white noise, its standard deviation is a constant, so we can normalize its magnitude as 1.

Notice that when $N \to \infty$,

$$cov(m,\Re) = \lim_{N\to\infty}\frac{\sum_{i=1}^{N}\left(\hat{m}_i - m_{ST}\right)\left(\hat{\Re}_i - \Re\right)}{N}$$

$$\equiv \langle \Delta m \Delta \Re \rangle \tag{4.8}$$

which is the LHS of the uncertainty relation expression as we claimed in (4.4). The following task is to calculate its explicit value.

We now cut the time into slides along the classical velocity of the particle. On each time slide, we only need to consider the collision of STPs parallel to the time slide. Defining the time interval for the cutting as $\delta\tau$. the instantaneous mass at the moment i could be defined as follows: from the moment $i-1$ to i, the action changing causing by STP collisions is $\Delta S_i = S_i - S_{i-1}$; Meanwhile the diffusion area is $\hat{\Re}_i$. The instantaneous mass is

$$\hat{m}_i \equiv \frac{\Delta S_i}{\hat{\Re}_i} \tag{4.9}$$

To varifying the (4.9) matches the statistical definition as in previous chapter, we need to reform the changing of action as the changing of motion status of the particle, it is

$$\Delta S_i = \frac{1}{4\pi} m_{ST}(V_i^2 - V_{i-1}^2)\delta\tau \tag{4.10}$$

hereV_i and V_{i-1}represent real velocities at moment i and $i-1$. Because there is no changing of classical velocity from moment $i-1$ to moment i , meanwhile the differentiable part of the collision, aka the quantum envelope velocity is also a slow varying quantity, so it could be seen as unchanged in this time interval. Thus all changing of the velocity is contributed from the STP noise. In classical situation, the previous equation could be written as

$$\begin{aligned}\Delta S_i &= \frac{1}{2}m(V_i^2 - V_{i-1}^2)\delta\tau \\ &= \frac{1}{2}m\left((V_{i-1}+\nu_i)^2 - V_{i-1}^2\right)\delta\tau \\ &= \frac{1}{2}m\left(\nu_i^2 + 2V_{i-1}\nu_i\right)\delta\tau \end{aligned} \tag{4.11}$$

Taking the mean value of this equation, we obtain

$$\begin{aligned}\langle\sum_i \Delta S_i\rangle_\nu &= \langle\int \frac{1}{2}m\left(\nu_i^2 + 2V_{i-1}\nu_i\right)dt\rangle_\nu \\ &= \hbar/4 \end{aligned} \tag{4.12}$$

However, it is notable that the changing caused by STP collisions is not a classical kinetic variation, we need to consider the special relativety effect as well. In rest frame of classical velocity, the particle energy is

$$E = mc^2$$

In static observer frame, its energy is

$$E_0 = \frac{m_0c^2}{\sqrt{1 - V^2/c^2}} \tag{4.13}$$

Therefore we obtain

$$\begin{aligned}\Delta S_i &= \left[\frac{m_0c^2}{\sqrt{1-\frac{V_i^2}{c^2}}} - \frac{m_0c^2}{\sqrt{1-\frac{V_{i-1}^2}{c^2}}}\right]\frac{\delta\tau_0}{\sqrt{1-\frac{V_{i-1}^2}{c^2}}} \\ &= \frac{m_0c^2\delta\tau_0}{\sqrt{\left(1-\frac{(V_{i-1}+\nu_i)^2}{c^2}\right)\left(1-\frac{V_{i-1}^2}{c^2}\right)}} - \frac{m_0c^2\delta\tau_0}{\left(1-\frac{V_{i-1}^2}{c^2}\right)} \\ &= \frac{m_0c^2\delta\tau_0\left(\sqrt{\left(1-\frac{V_{i-1}^2}{c^2}\right)} - \sqrt{\left(1-\frac{(V_{i-1}+\nu_i)^2}{c^2}\right)}\right)}{\left(1-\frac{V_{i-1}^2}{c^2}\right)\sqrt{\left(1-\frac{(V_{i-1}+\nu_i)^2}{c^2}\right)}} \end{aligned} \tag{4.14}$$

especially, in above equation, we used the special relativity transformation that

$$m_i = \frac{m_0}{\sqrt{1-\frac{V_i^2}{c^2}}} \tag{4.15}$$

Because the changing of action from $i-1-th$ to $i-th$ time slide is a Lorentz scalar. We can take the $i-1-th$ slide as the rest frame with mass m_{i-1}, the $i-th$ slide represents the frame with velocity ν_i. Therefore, we change the equation (4.14) as

$$\Delta S_i = \left(\frac{m_{i-1}c^2}{\sqrt{1-\nu_i^2/c^2}} - m_{i-1}c^2\right)\delta\tau_i \tag{4.16}$$

$$= \left(\frac{1}{2}m_{i-1}\nu_i^2 + \frac{3}{8}(\nu_i^2/c^2)^2c^2m_{i-1} + \cdots\right)\delta\tau_i$$

Taking mean value of the above, we obtain

$$\langle\left(\frac{1}{2}m_{i-1}\nu_i^2 + \frac{3}{8}(\nu_i^2/c^2)^2c^2m_{i-1} + \cdots\right)\delta\tau_i\rangle_\nu$$

$$= \frac{\hbar}{4} + \frac{3\hbar^2}{32c^2m_{i-1}\delta\tau_i} + \frac{5\hbar^3}{256c^4m_{i-1}^2\delta\tau_i^2}\cdots \tag{4.17}$$

When the cutting interval goes to the classical limit, say, $\delta\tau_i \gg 0$, and the number $\hbar/c$ is very small, we have:

$$\langle\hat{m}_i\hat{\Re}_i\rangle_\nu \simeq \frac{\hbar}{4} \tag{4.18}$$

It means at arbitrary time slide, the mean value of the product of instantaneous mass and diffusion coefficient is $\frac{\hbar}{4}$.

From the definition of statistical inertia mass $m_{ST}$and diffusion coefficient $\Re$, we have:

$$\Re \equiv \sum_{i=1}^{N}\hat{\Re}_i/N \tag{4.19}$$

$$m_{ST} \equiv 2\pi\sum_{i=1}^{N}\hat{m}_i/N \tag{4.20}$$

It will not change the essence of the relation

$$\langle m_{ST}\Re\rangle_\nu = \frac{h}{2}$$

This is because

$$\langle m_{ST}\Re\rangle_\nu = 2\pi\langle\sum_{i=1}^{N}\hat{m}_i/N\sum_{j=1}^{N}\hat{\Re}_j/N\rangle_\nu$$

$$= 2\pi\left[\sum_{i=j}^{N}\frac{\langle\hat{m}_i\hat{\Re}_i\rangle_\nu}{N^2} + \sum_{i\neq j}^{N}\frac{\langle\hat{m}_i\hat{\Re}_j\rangle_\nu}{N^2}\right]$$

$$= \frac{h}{4N} + 2\pi \frac{\sum_{i=1}^{N} \langle \hat{m}_i \rangle \sum_{j \neq i}^{N} \langle \hat{\Re}_j \rangle}{N^2} + \mathcal{O}(\frac{h^2}{c^2 N})$$

$$= \frac{h}{4N} + \frac{N-1}{N}\frac{h}{2} + \mathcal{O}(\frac{h^2}{c^2 N}) = \frac{h}{2} - \frac{h}{4N} - \mathcal{O}(\frac{h^2}{c^2 N}) \tag{4.21}$$

when $N \to \infty$, $\langle m_{ST}\Re \rangle_\nu = \frac{h}{2}$. Therefore we know the time cutting definition and the statistical definition is coincident with each other.

Now we can calculate the covariance as following

$$cov(m, \Re) = \lim_{N\to\infty} \frac{\sum_{i=1}^{N} \Delta S_i - m_{ST} \sum_{i=1}^{N} \hat{\Re}_i - \Re \sum_{i=1}^{N} \hat{m}_i}{N} + h/2 \tag{4.22}$$

and we obtain:

$$cov(m, \Re) = \lim_{N\to\infty} \frac{\sum_{i=1}^{N} \Delta S_i}{N} - h/2 \tag{4.23}$$

From MIP, the changing of action caused by STP collsion is N times of Planck constant, where N is an arbitrary integer, when the number of collisions goes to infinity, it is obvious that

$$\lim_{N\to\infty} \frac{\sum_{i=1}^{N} \Delta S_i}{N} = \lim_{N\to\infty} \frac{\hbar/4}{N} = 0 \tag{4.24}$$

at last we obtain

$$\langle \Delta m \Delta \Re \rangle = h/2 \tag{4.25}$$

and the proof is closed.

c) Position-Momentum Uncertainty Relation

Extending the definition of commutation relation, and recall $m = m_{ST}/2\pi$, we consider the position-momentum commutator

$$[x, p] = \lim_{\epsilon\to 0} \left(\frac{1}{2\pi} x(t + i\epsilon) m_{ST} \frac{\delta x(t)}{\delta t} - \frac{1}{2\pi} m_{ST} \frac{\delta x(t + i\epsilon)}{\delta t} x(t) \right)$$

$$= \lim_{\epsilon\to 0} \left(i\frac{\epsilon}{2\pi} \left[m_{ST} \left(\frac{\delta x(t)}{\delta t} \right)^2 - m_{ST} \frac{\delta^2 x(t)}{\delta t^2} x(t) \right] \right) \tag{4.26}$$

Here we didn't take the statistical inertia mass as a variable, because when considering the changing of the particle's position caused by STP collisions, its statistical property is unchanged. Noticed that in our derivation, the momentum and position both have its instantaneous value. However, the two measurements are not isochronous in priori. Our isochrony is essencially different from what in quantum mechanism. Here since there exist collisions between STPs and matter particle, any two measurements can not be exactly isochronous. We let the time interval ϵ goes to zero to achieve an isochronous commutation relation in posteriori.

Define

$$a_{ST}(t) := \frac{\partial^2 x(t)}{\partial t^2} \tag{4.27}$$

It is the instantaneous accelaration induced by the collison between STP and the particle. From which we can define the instantaneous "spacetime" force as

$$F_{ST}(t) = m a_{ST}(t) = m \frac{\delta^2 x(t)}{\delta t^2} \tag{4.28}$$

The statistical average of eq.(4.26) is

$$[x, p] = \lim_{\epsilon \to 0} \left(m \langle V(t)^2 \rangle_\nu i\epsilon - \langle F_{ST}(t) x(t) \rangle_\nu i\epsilon \right) \tag{4.29}$$

Its second term has an explicit meaning in physics. It is the the mean work done by STP acting on the particle. Obviously, this mean work is zero.

Now we consider the contribution from the first term of eq.(4.29) Under discretization of the fluctuation, the average speed is

$$\int_t^{t+\epsilon} \nu(\tau) d\tau / \epsilon = \bar{\nu} / \sqrt{\epsilon}$$

therefore

$$\langle \nu^2 \rangle_\nu = \langle \bar{\nu}^2 \rangle_\nu / \epsilon = \frac{h}{m_{ST} \epsilon} \tag{4.30}$$

Substitude this into the first term of Eq. (4.29), we obtain

$$\begin{aligned} [x,\ p] &= \lim_{\epsilon \to 0} \left(i\epsilon m \langle \nu^2 \rangle_\nu + i\epsilon \langle U^2 \rangle_\nu \right) \\ &= \lim_{\epsilon \to 0} i\epsilon m \frac{h}{m_{ST} \epsilon} + 0 = i\hbar \end{aligned} \tag{4.31}$$

which is the most fundamental hypothesis of quantum mechanism, the position-momentum uncertainty relation.

d) Energy-Time Uncertainty Relation

Within the framwork of non-relativity quantum mechanism, the position-momentum uncertainty relation does not imply the energy-time uncertainty. This means we can not derive one kind of uncertainty relation from the other. Notice, position, momentum, energy are all dynamical variables. They are functions of time t, say, the time t is a self-variable. Experimentally, because in non-relativity quantum mechanism, time t is an independent variable and does not rely on particle status, we can measure the position, momentum, energy of a matter particle.

Now we define the Δt in energy-time uncertainty relation as: the characteric time describing a significant variation in the system study at hand. To describe the variation, we have to introduce a time-varying physical quantity Q. The 'significant' variation is defined as the time interval in which the Q changing by one standard deviation σ_Q. Mathematically, it is expressed as:

$$\sigma_Q = |\frac{d}{dt}\langle Q\rangle_\nu| \times \Delta t \tag{4.32}$$

Meanwhile, we can define the ΔE in energy-time uncertainty relation as the uncertainty of Hamiltonian of the system σ_H. The average evolution equation of Q along with the time is

$$\frac{d}{dt}\langle Q\rangle_\nu = \frac{i}{\hbar}\langle[H, Q]\rangle_\nu \tag{4.33}$$

combine with the Schwarz inequality in mathematics, we have

$$\sigma_H^2\sigma_Q^2 \geq \left[\frac{1}{2i}\langle[H, Q]\rangle_\nu\right]^2 \tag{4.34}$$

and then substitude into the definition of ΔE andΔt, we arrive:

$$\Delta E\Delta t \geq \frac{\hbar}{2} \tag{4.35}$$

If any physical quantity in this system varies fast, say Δt is very small, then its energy uncertainty will be very large. If ΔE is very small, then the Δt is very large, it means all observables in this system are varying slow.

VI. Random Motion of Free Particle under MIP

a) Decompositions of the Real Velocity

In modern quantum mechanics, particles do not have trajectories of motions, so their velocities are not well defined. Within the framework of MIP, the real velocity of the particles must be discussed in detail. Under the impact of STP, the velocity of the particle not only contains the classical velocity, but also the results of random mechanical interactions. It is especially important that the particles are subjected to the impact of the STP, and the change of action is quantized. Therefore, the real velocity of the particles should reflect the classical, random and quantum properties.

Within the framework of MIP, the motion of particles is a frictionless Brownian motion. However, it should be noted that the impact of STP is not completely random. The exchanged action that each particle is subjected to STP is an integer multiple of the Planck constant h. Therefore, the movement of particles in spacetime cannot be a problem of random mechanics completely. It is the quantization of randomized motions. The corresponding theoretical system is a Markov process. If there is no STP and other external forces, the motion of the free particles satisfies Newtonian mechanics. Its velocity is the classic velocity. Within the framework of MIP, for the real velocity of motion of free particles $\vec{V}(\vec{x}, t)$, we can first isolate the classical statistical velocity of the particle $\vec{v}(\vec{x}, t)$. In the context of spacetime, it is a simple mean of the statistics of the impact of STP as Gaussian noise. Since the simple mean contribution of Gaussian noise is zero, the classical statistical velocity of the particle and the classical velocity under Newtonian mechanics are exactly equal. Second, after separating the classical statistical velocity $\vec{v}(\vec{x},t)$, we will consider a random motion. This random motion is driven by the impact of STP, and we note it with the random motion velocity $\vec{W}(\vec{x},t)$. In Appendix B of this paper, we prove that any random function can be decomposed into a random function and a superposition of differentiable functions. Random motion under the framework of MIP also follows this important principle. Therefore, in general, we can decompose the random motion velocity $\vec{W}(\vec{x},t)$ as follow

$$\vec{W}(\vec{x},t) = \vec{u}(\vec{x},t) + \vec{\nu}(t) \tag{5.1}$$

Where $\vec{u}(\vec{x},t)$ is defined as the quantum envelope velocity of the particle. For free particles, $< \vec{u}(\vec{x},t) >_\nu = 0$. It corresponds to the perturbation part of the random motion. It reflects the physical fact that the impact of STP is random, but it is a small perturbation to the current motion of the particle. These impacts are "differential impacts" of STP on the particles. Under the action of the pertubation of space-time, the motion of particles is not an unpredictable random motion. It allows the motion state of particles to be described by a differentiable function and describes the corresponding motion state . The equation is a non-random partial differential equation. And $\vec{\nu}(t)$ represents the non-microscopic impact of the particle by STP, which is a non-perturbative effect on the velocity of the particle motion. We define it as the velocity of fluctuation. Because of the existence of such random impact, the state function that we finally describe the equation of motion of the particle will not be an accurate description. It can only be a probabilistic description on the background of this fluctuation.

We will see that in the framework of MIP, quantum envelope motion reflects the wave-particle duality of particles. Considering the impact between STP and particle, the amount of exchange action is nh. For particles with a statistical mass of m_0, the characteristic time of this collision is

$$t_c = \frac{nh}{m_0 c^2} \tag{5.2}$$

The so-called quantum envelope motion is essentially the differentiable part of the fluctuation motion.

The above discussion is based on the classification of particles by the impact of STP. From the above analysis we can see that there is actually another mathematical classification for the velocity of the particles, and we decompose the velocity of the particle into a differentiable part and a non-differentiable part. The differentiable part of the real motion velocity of a particle can be defined as:

$$\vec{U}(\vec{x},t) = \vec{v}(\vec{x},t) + \vec{u}(\vec{x},t) \tag{5.3}$$

It is a superposition of classic statistical velocity $\vec{v}(\vec{x},t)$ and quantum envelope velocity $\vec{u}(\vec{x},t)$. We call this differentiable velocity “statistical average velocity”. Although mathematically it is a differentiable function, it is quite different from the classical velocity.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Because there is a quantum envelope velocity $\vec{u}(\vec{x},t)$, it is a representation of the Markov process formed by the impact of STP. Therefore, the decomposition of the velocity of the particles caused by the collision of STP can be written in three parts in principle[5]:

$$\vec{V}(\vec{x},t) = \vec{u}(\vec{x},t) + \vec{v}(\vec{x},t) + \vec{\nu}(t) \tag{5.4}$$

Since a Markov process will still be a Markov process under time reversal[9], the quantum envelope velocity $\vec{u}(\vec{x},t)$ is invariant under time reversal as

$$T : \vec{u}(\vec{x},t) \to \tilde{\vec{u}}(\vec{x},t) = \vec{u}(\vec{x},t) \tag{5.5}$$

However, the classical statistical velocity $\vec{v}(\vec{x},t)$ is changed by the time reversal, that is,

$$T : \vec{v}(\vec{x},t) \to \tilde{\vec{u}}(\vec{x},t) = -\vec{v}(\vec{x},t) \tag{5.6}$$

With above properties of time reversal, we can have a well defined limit $\vec{u} = 0$ as Newtonian mechanics with

$$\vec{v} = \frac{1}{2}(\vec{U} - \tilde{\vec{U}}) \tag{5.7}$$

$$\vec{u} = \frac{1}{2}(\vec{U} + \tilde{\vec{U}}) \tag{5.8}$$

Where $\tilde{\vec{U}}$is the time reversal of the statistical average velocity $\vec{U}$. In the following, the physical quantities with time reversal are marked with tilde.

The non-differentiable part is the fluctuation velocity $\vec{\nu}(t)$ for the random "non-differentiable impact"of the particle. It causes the particle's velocity to deviate from the classical statistical mean, so it will be physically reflected as a random diffusion behavior of the particle in spacetime. Based on this, we named it the "diffusion velocity" of particles in space and time.

In the following subsections, we will see that the decomposition of the above two velocities is a very important theoretical basis for deriving the equation of motion of particles, that is, the Schrödinger equation in quantum mechanics and an in-depth understanding of its physical meaning.

b) From MIP to Schrödinger Equation

Without the interaction of spacetime, the velocity of particle $\vec{v}$ has to be the derivative $\vec{v} = \frac{d\vec{x}}{dt}$. Contrasting from usual Markov process, spacetime random motion is frictionless, otherwise the quantum effect of a particle will decay as time going, which is obviously not the case. According to the MIP, the coordinate of a free particle is a stochastic process $\vec{x}(t)$, in which the velocity $\vec{V}$ can not be expressed in terms of $\frac{d\vec{x}}{dt}$. The velocity $\vec{V}$ should be a statistical average corresponding to a distribution $\delta\vec{x} = \vec{x}(t+\frac{1}{\omega}) - \vec{x}(t)$, at the limit of

[5] After we finished our manuscript, we found that this three-velocity decomposition is in fact consistent with Wold's decomposition theorem of the stochastic process in.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

spacetime collision frequency ω going to infinity. In Einstein's theory on Brownian motion, $\delta\vec{x}$ is a Gaussian distribution with zero mean and variance proportional to $\frac{1}{\omega}$[6]. However, Einstein's theory cannot be correct at the limit of spacetime collision frequency ω going to infinity[10, 11]. Therefore, we will construct the operator D as following, which plays the same role as $\frac{d}{dt}$ in Newtonian Mechanics. For any physical function $f(\vec{x},t)$, we have

$$\begin{aligned}
&\omega(f(\vec{x}(t+\frac{1}{\omega}),t+\frac{1}{\omega})-f(\vec{x}(t),t))\\
&=[\partial_t+\sum_i\omega(x_i(t+\frac{1}{\omega})-x_i(t))\partial_i\\
&\quad+\sum_{ij}\frac{\omega}{2}(x_i(t+\frac{1}{\omega})-x_i(t))(x_j(t+\frac{1}{\omega})-x_j(t))\partial_i\partial_j\\
&\quad+\sum_i(x_i(t+\frac{1}{\omega})-x_i(t))\partial_i\partial_t+\frac{1}{2\omega}\partial_t^2]f(\vec{x}(t),t)
\end{aligned}\tag{5.9}$$

At the limit of spacetime collision frequency ω going to infinity, in terms of statistical average $< ... >$ for δx, we can define the operator D as

$$Df(x(t),t) = \lim_{\omega\to+\infty}\omega\langle f(\vec{x}(t+\frac{1}{\omega}),t+\frac{1}{\omega})-f(\vec{x}(t),t)\rangle_\nu \tag{5.10}$$

$$= (\partial_t+\sum_i U_i\partial_i+\sum_{ij}\Re_{ij}\partial_i\partial_j)f(\vec{x}(t),t) \tag{5.11}$$

where we used

$$\vec{U} = \lim_{\omega\to+\infty}\omega\langle\delta\vec{x}\rangle_\nu \tag{5.12}$$

it relates to the descreterization of Lagevin equation

$$x_i(t+\epsilon)-x_i(t)=\epsilon U_i(\mathbf{x}(t))+\sqrt{\epsilon}\bar{\nu}_i+O(\epsilon^2) \tag{5.13}$$

here

$$\epsilon=\frac{1}{\omega} \tag{5.14}$$

In eq.(5.10) , we used the following deduced result

$$\begin{aligned}
\lim_{\omega\to+\infty}\frac{\omega\langle\delta x_i\delta x_j\rangle_\nu}{2} &= \lim_{\epsilon\to0^+}\frac{1}{2\epsilon}\langle(x_i(t+\epsilon)-x_i(t))(x_j(t+\epsilon)-x_j(t))\rangle_\nu\\
&= \lim_{\epsilon\to0^+}\frac{1}{2\epsilon}\left[\langle\epsilon^2U_i(\mathbf{x}(\mathbf{t}))U_j(\mathbf{x}(t))\rangle_\nu+\epsilon\langle\bar{\nu}_i\bar{\nu}_j\rangle_\nu+\epsilon^{\frac{3}{2}}\langle(U_i\bar{\nu}_j+U_j\bar{\nu}_i)\rangle_\nu\right]\\
&= \frac{h}{2m_{ST}}\delta_{i,j}
\end{aligned}\tag{5.15}$$

Because of the isotropy of space, the MIP coefficient will be

$$\Re_{ij} = \frac{\hbar}{2m_{ij}} = \Re\delta_{ij} \tag{5.16}$$

which is consistent with Eq.3.30 and 3.39. The operator D and its time reversal $\tilde{D}$ are

$$D = \partial_t + \vec{U} \cdot \nabla + \Re\nabla^2 \tag{5.17}$$

$$\tilde{D} = -\partial_t + \tilde{\vec{U}} \cdot \nabla + \Re\nabla^2 \tag{5.18}$$

Therefore, the statistical average velocity of particle $\vec{V}$ can be written as

$$\vec{U} = D\vec{x} \tag{5.19}$$

$$\tilde{\vec{U}} = \tilde{D}\vec{x} \tag{5.20}$$

Correspondingly, its classical statistical velocity and quantum envelope velocity are

$$\vec{v} = D^{-}\vec{x} \tag{5.21}$$

$$\vec{u} = D^{+}\vec{x} \tag{5.22}$$

with

$$D^{-} = \frac{1}{2}(D - \tilde{D}) \tag{5.23}$$

$$D^{+} = \frac{1}{2}(D + \tilde{D}) \tag{5.24}$$

We define the statical average acceleration of particles as

$$\begin{aligned} \vec{a} &= D\vec{U} = (D^{+} + D^{-})(\vec{v} + \vec{u}) \\ &= D^{+}\vec{u} + D^{-}\vec{v} + D^{-}\vec{u} + D^{+}\vec{v} \end{aligned} \tag{5.25}$$

Under time reversal, it acts as

$$\begin{aligned} \tilde{\vec{a}} &= \tilde{D}\tilde{\vec{U}} = (D^{+} - D^{-})(-\vec{v} + \vec{u}) \\ &= D^{+}\vec{u} + D^{-}\vec{v} - D^{-}\vec{u} - D^{+}\vec{v} \end{aligned} \tag{5.26}$$

Define the classical average acceleration as

$$\vec{a}_c = \frac{1}{2}(\vec{a} + \tilde{\vec{a}}) = D^{+}\vec{u} + D^{-}\vec{v}, \tag{5.27}$$

obviously it is invariant under time reversal. The average acceleration of a free particle must be zero, which can be written as

$$D^+\vec{v} + D^-\vec{u} = 0. \tag{5.28}$$

However, the average acceleration of quantum envelope motion can not simply be zero,

$$D^+\vec{u} + D^-v \neq 0 \tag{5.29}$$

At classical and low speed case, the average acceleration of quantum envelope motion does not relate to classical statistical velocity, therefore we can have

$$D^-\vec{v} - D^+\vec{u} = 0. \tag{5.30}$$

These conditions are equivalent to the coupled non-linear partial differential equations as following

$$\frac{\partial \vec{u}}{\partial t} = -\Re\nabla^2\vec{v} - \nabla(\vec{u}\cdot\vec{v}) \tag{5.31}$$

$$\frac{\partial \vec{v}}{\partial t} = -(\vec{v}\cdot\nabla)\vec{v} + (\vec{u}\cdot\nabla)\vec{u} + \Re\nabla^2\vec{u} \tag{5.32}$$

Random motions of free particles due to the random impacts of STP satisfy the Markov property, one can make predictions for the future of the process based solely on its present state just as well as one could know the process's full history. This is the simplest situation for random motions, the free particle does not involve any external potential. Now, we have an initial value problem, which is to solve $\vec{u}(\vec{x},t)$ and $\vec{v}(\vec{x},t)$given $\vec{u}(\vec{x},0) = \vec{u}_0(\vec{x})$, $\vec{v}(\vec{x},0) = \vec{v}_0(\vec{x})$. In order to solve the coupled non-linear partial differential equations, we have to linearise it firstly[12, 13, 14]. Let

$$\Psi = e^{R+iI}, \tag{5.33}$$

where

$$\nabla R = \frac{1}{2\Re}\vec{u} \tag{5.34}$$

$$\nabla I = \frac{1}{2\Re}\vec{v} \tag{5.35}$$

We can obtain

$$\frac{\partial \Psi}{\partial t} = i\Re\nabla^2\Psi \tag{5.36}$$

According to the MIP, the universal spacetime diffusion coefficient is the MIP coefficient $\Re = \frac{\hbar}{2m_{ST}}$. Substituting to the last equation, we will get the equation of motion of free particles as

$$i\frac{\partial \Psi}{\partial t} = -\frac{\hbar\nabla^2}{2m_{ST}}\Psi \tag{5.37}$$

which is the Schrödinger equation essentially.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

According to the continuity equation

$$\partial_t \rho(\vec{r}, t) + \nabla \cdot \vec{J} = 0 \tag{5.38}$$

The definition of particle current is density multiplied by velocity. In the framework of MIP, the velocity in this definition corresponds to the classical statistical velocity. (See Appendix C)We can naturally derive the Born's interpretation as follows:

$$\vec{J} = \rho \vec{v} \tag{5.39}$$

among them

$$\vec{v} = 2\Re \nabla I \tag{5.40}$$

Substitute (5.33) in Schrödinger equation

$$\partial_t \Psi = i\Re \nabla^2 \Psi \tag{5.41}$$

Let the real and imaginary parts be equal respectively, there are

$$\partial_t R + \Re(2\nabla R \cdot \nabla I + \nabla^2 I) = 0 \tag{5.42}$$

and

$$\partial_t \rho(\vec{r}, t) + \nabla \cdot (\rho \vec{v}) = 0 \tag{5.43}$$

which can be solved as

$$\rho = e^{2R} \tag{5.44}$$

Therefore, we show that the distribution of the particle number density is exactly the wave function modulo square. Further considering the ensemble of many identical particles, the particle number density is interpreted as the probability density, which is exactly the Born's interpretation.

The Born rule is a law of quantum mechanics which gives the probability that a measurement on a quantum system will yield a given result, which became a fundamental ingredient of Copenhagen interpretation[15]. In this paper, we attempt to suggest an interpretation of Born rule according to the MIP, which can provide a realistic point of view for wave function. Emerging from random impacts of spacetime, it's absolutely necessary that wave function is complex. If wave function were a real sine or cosine function[16], according to $\rho = |\Psi|^2$, the probabilistic density of a free particle with definite momentum would oscillate periodically which violates the isotropy of physical space. Under the framework of this paper, we can prove the 'Uncertain principle' directly(For more details, see Appendix D).

c) *Physical Meanings of Potential Functions R and I*

Substituting $\Psi = e^{R+iI}$ into $\frac{\partial \Psi}{\partial t} = i\Re\nabla^2\Psi$, we equalise the real and imaginary part separately as

$$\partial_t R = -\Re(2\nabla R \cdot \nabla I + \nabla^2 I) \tag{5.45}$$

$$\partial_t I = \Re[(\nabla R)^2 - (\nabla I)^2 + \nabla^2 R] \tag{5.46}$$

Combining with previous result $\rho = |\Psi|^2 = e^{2R}$, we have

$$\partial_t \rho = 2\rho \partial_t R \tag{5.47}$$

$$\nabla \rho = 2\rho \nabla R \tag{5.48}$$

The differential equation of potential R can be turned into

$$\partial_t \rho = -2\Re \nabla \cdot (\rho \nabla I) \tag{5.49}$$

With $\nabla I = \frac{1}{2\Re}\vec{v}$, the differential equation of potential R is equivalent to the equation of continuity

$$\partial_t \rho + \nabla \cdot (\rho \vec{v}) = 0 \tag{5.50}$$

Noticing that the classical momentum of particle is $m\vec{v} = \hbar \nabla I$, we find that the differential equation of potential I goes to

$$\partial_t(\hbar I) + \frac{(\nabla(\hbar I))^2}{2m} - \hbar\Re[(\nabla R)^2 + \nabla^2 R] = 0 \tag{5.51}$$

Comparing with the Hamilton-Jacobi equation from classical mechanics [17, 18] as

$$\partial_t S + \frac{(\nabla S)^2}{2m} + V(x) = 0 \tag{5.52}$$

which is particularly useful in identifying conserved quantities for mechanical systems. There are two crucial remarks: Firstly, potential function I is proportional to the Hamilton-Jacobi function S as $S = \hbar I$. Secondly, for a free particle, the influence of spacetime can be summed up to the spacetime potential

$$V_{ST} = -\hbar\Re[(\nabla R)^2 + \nabla^2 R] \tag{5.53}$$

where the spacetime potential V_{ST} will play the same role of potential V in the Hamilton-Jacobi equation. The spacetime potential V_{ST} vanishes in the classical limit $\hbar = 0$, which is equivalent to $V = 0$ for free particles in classical mechanics. The quantum effect, which corresponding to nonzero $\hbar$, now is the natural result of the existence of the spacetime potential V_{ST}, induced by MIP. In principal, the moving of free particle can be described precisely by the spacetime potential V_{ST} as

$$m\frac{d^2\vec{x}}{dt^2} = -\nabla V_{ST} = \hbar\Re\nabla[(\nabla R)^2 + \nabla^2 R] \tag{5.54}$$

This equation indicates that free particle moves not along straight line within interactions of STP. It is affected by a space-time potential V_{ST}. The interactions between STP and particle give the statistcal mass to particle.

d) Space-time Random Motion of Charged Particles in Electromagnetic Field

According to the MIP, in case of low speed, electromagnetic field only serves as an external potential, which itself is not affected by random impacts of spacetime. In a electromagnetic field $(\vec{E}, \vec{B})$, the charged particle will experience a Lorentz force $\vec{F} = e(\vec{E}+\vec{v}\times\vec{B})$. Therefore, the average acceleration [19] of charged particles will be

$$\vec{a} = e(\vec{E} + \vec{v} \times \vec{B})/m \tag{5.55}$$

where m is the inertial mass of charged particle and e is the charge. Based on the spacetime principle, we are able to derive the equation of motion of charged particle in electromagnetic field, which is finally shown to be Schrödinger equation in electromegnatic field, which is

$$i\hbar\partial_t\Psi = \frac{1}{2m}(-i\hbar\nabla - \frac{e}{c}\vec{A})^2\Psi + e\phi\Psi \tag{5.56}$$

where the electromagnetic potential and the electromagnetic field are connected by

$$\vec{B} = \nabla \times \vec{A}, \vec{E} = -\partial_t\vec{A} - \nabla\phi. \tag{5.57}$$

We do not have average acceleration in absence of electromagnetic field. However, this is not the case when the particle have non-zero electric charge, moving in external electromagnetic field. Identifying the velocity in the Lorentz force as the classical velocity of random motion of particle in spacetime, we have

$$\partial_t\vec{v} = e(\vec{E} + \vec{v} \times \vec{B})/m - (\vec{v}\cdot\nabla)\vec{v} + (\vec{u}\cdot\nabla)\vec{u} + \Re\nabla^2\vec{u} \tag{5.58}$$

In the electromagnetic field, the equation of motion of charged particle becomes coupled non-linear partial differential equations as following

$$\frac{\partial\vec{u}}{\partial t} = -\Re\nabla(\nabla\cdot\vec{v}) - \nabla(\vec{u}\cdot\vec{v}) \tag{5.59}$$

$$\begin{aligned}\frac{\partial\vec{v}}{\partial t} = e(\vec{E} + \vec{v} \times \vec{B})/m - (\vec{v}\cdot\nabla)\vec{v} \\ +(\vec{u}\cdot\nabla)\vec{u} + \Re\nabla^2\vec{u}\end{aligned} \tag{5.60}$$

In order to solve the coupled non-linear partial differential equations, we have to linearise it firstly. Let $\Psi = e^{R+iI}$ and notice that the canonical momentum of charged particle [20] is $\vec{p} = m\vec{v} + e\vec{A}/c$, we suppose

$$\nabla R = \frac{1}{2\Re}\vec{u} \tag{5.61}$$

$$\nabla I = \frac{1}{2\Re}(\vec{v} + \frac{e\vec{A}}{mc}) \tag{5.62}$$

In order to prove Eq.(5.56), we expand the first term of right side of Eq.(5.56) as

$$\begin{aligned}\frac{1}{2m}(-i\hbar\nabla - \frac{e}{c}\vec{A})^2\Psi &= -\frac{\hbar^2\nabla^2}{2m}\Psi + \frac{e^2A^2}{2mc^2}\Psi \\ &+\frac{i\hbar e}{2mc}(\nabla\cdot\vec{A})\Psi + \frac{i\hbar e}{mc}\vec{A}\cdot(\nabla\Psi)\end{aligned} \tag{5.63}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Substituting $\Psi = e^{R+iI}$, it leads to

$$-\frac{\hbar^2}{2m}[\nabla^2 R + i\nabla^2 I + (\nabla R + i\nabla I)^2]\Psi + \frac{e^2 A^2}{2mc^2}\Psi$$
$$+\frac{i\hbar e}{2mc}(\nabla \cdot \vec{A})\Psi + \frac{i\hbar e}{mc}(\vec{A} \cdot (\nabla R + i\nabla I))\Psi \tag{5.64}$$

With vector formulas

$$\nabla(\vec{A} \cdot \vec{B}) = \vec{A} \times (\nabla \times \vec{B}) + \vec{B} \times (\nabla \times \vec{A})$$
$$+(\vec{A} \cdot \nabla)\vec{B} + (\vec{B} \cdot \nabla)\vec{A} \tag{5.65}$$

$$\nabla(\nabla \cdot \vec{A}) = \nabla \times (\nabla \times \vec{A}) + \nabla^2 \vec{A} \tag{5.66}$$

and Eq.(5.61), we will obtain

$$\nabla \times \vec{u} = 0 \tag{5.67}$$

$$\nabla \times (\vec{v} + \frac{e\vec{A}}{mc}) = 0 \tag{5.68}$$

Straightforwardly, we have

$$i\hbar(\partial_t R + i\partial_t I) = -\frac{\hbar^2}{2m}[\nabla^2 R + i\nabla^2 I$$
$$+(\nabla R + i\nabla I)^2] + \frac{e^2 A^2}{2mc^2} \tag{5.69}$$
$$+\frac{i\hbar e}{2mc}(\nabla \cdot \vec{A}) + \frac{i\hbar e}{mc}(\vec{A} \cdot (\nabla R + i\nabla I)) + e\phi$$

Now, let's prove that the real and imaginary parts are separately equaled as

$$\partial_t I = \frac{\hbar}{2m}(\nabla^2 R + (\nabla R)^2 - (\nabla I)^2)$$
$$-\frac{e^2 \vec{A}^2}{2mc^2} + \frac{e}{mc}(\vec{A} \cdot (\nabla I)) - \frac{e\phi}{\hbar} \tag{5.70}$$

$$\partial_t R = -\frac{\hbar}{2m}(\nabla^2 I + 2(\nabla R) \cdot (\nabla I))$$
$$+\frac{e}{2mc}(\nabla \cdot \vec{A}) + \frac{e}{mc}\vec{A} \cdot (\nabla R) \tag{5.71}$$

Taking the gradient from both sides and the definitions $\vec{B} = \nabla \times \vec{A}, \vec{E} = -\partial_t \vec{A} - \nabla\phi$, we have reproduced the Eq.(5.59). Therefore, we have proved that both sides of Eq.(5.59) are at most different from a zero gradient function. It's important to notice that the choices of electromagnetic potentials are not completely determined. It allows a gauge transformation [20]

$$\vec{A}' = \vec{A} + \nabla\Lambda \tag{5.72}$$

$$\phi' = \phi - \partial_t \Lambda \tag{5.73}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

For any function $\Lambda(\vec{x}, t)$, the electromagnetic field is invariant. Therefore, the corresponding wave function cannot change essentially, at most changing a local phase factor. Given $' = \psi e^{\frac{ie\Lambda}{\hbar c}}$, Schrödinger equation of charged particle in electromagnetic field is invariant, i.e., $U(1)$ gauge symmetry. By choosing the function $\Lambda(\vec{x}, t)$ properly, we are able to eliminate the redundant zero gradient function. So we have proved Eq.(5.56) at the end.

e) *Stationary Schrödinger Equation from MIP*

Compare to the definition of classical statistical velocity as in eq.(5.35), it is easy to see that for the ground state, the classical statistical velocity is zero. Moreover, we can prove for all stationary states, their classical statistical velocities are zero. For a stationary state has exact energy E, the Schrödinger equation is

$$[-\frac{\hbar^2\nabla^2}{2m} + V_c(\vec{x})]\Psi = E\Psi \tag{5.74}$$

its conjugation reads

$$[-\frac{\hbar^2\nabla^2}{2m} + V_c(\vec{x})]\Psi^* = E\Psi^* \tag{5.75}$$

here $V_c(\vec{x})$ is classical external potential. Add the above two equations, the new real wave function has to satisfy the Schrödinger equation with same eigen-energy E.

Corresponding to the classical velocity from Eq.(5.35), it is easy to show that the classical velocity of particles must be zero in stationary states. Within the framework of MIP, we should interpret the stationary states from quantum mechanics as a spacetime random motion with zero classical velocity. Once we have all the stationary states, we will get the general solution by linear superposition. Therefore, we are going to derive stationary Schrödinger equation from classical velocity $\vec{v} = 0$, which can provide a clear physical picture of MIP. Moreover, when $|\vec{v}|$ is large and close to velocity of light c, the generalisation of this framework is clear and will be explained in our further work.

The trajectory of random motion of particle can be understood as the superposition of classical path and fluctuated path. During time interval $\triangle t$, there are two contributions to the trajectory as

$$\delta\vec{x} = \vec{u}(\vec{x}, t)\triangle t + \triangle\vec{x} \tag{5.76}$$

of which distribution satisfies $\varphi(\triangle\vec{x}) = \varphi(-\triangle\vec{x})$ and

$$\int \varphi(\triangle\vec{x})d(\triangle\vec{x}) = 1$$

. The spacetime coefficient reads

$$\Re = \frac{1}{2\triangle t}\int (\triangle\vec{x})^2\varphi(\triangle\vec{x})d(\triangle\vec{x}) \tag{5.77}$$

The probabilistic density $\rho(x, t)$ evolves [21, 22, 23] as

$$\rho(\vec{x}, t + \triangle t) = \int \rho(x - \delta\vec{x}, t)\varphi(\triangle\vec{x}))d(\triangle\vec{x}) \tag{5.78}$$

Expanding Taylor series of both sides, we have

$$\partial_t \rho = -\nabla \cdot (\rho \vec{u}) + \Re \nabla^2 \rho \tag{5.79}$$

which is consistent with Fokker-Planck equation. In any external potential $V(\vec{x})$, there are two contributions to the changing of average velocity. One is from random impacts of spacetime, another one is from acceleration provided by external potential. Therefore, the average velocity will evolve during time interval $\triangle t$ as

$$\vec{u}(\vec{x}, t+\triangle t) = \frac{\int (\vec{u}(\vec{x}-\delta\vec{x}, t) - \frac{\triangle t \nabla V(\vec{x}-\delta\vec{x})}{m}) \rho(x-\delta\vec{x}, t) \varphi(\triangle\vec{x})) d(\triangle\vec{x})}{\int \rho(x-\delta\vec{x}, t)\varphi(\triangle\vec{x})) d(\triangle\vec{x})} \tag{5.80}$$

the denominator of eq. 5.80 is the normalisation factor of the probability distribution. Expanding Taylor series of both sides, we obtain

$$m\frac{d\vec{u}}{dt} = -\nabla V + \Re m(\frac{\nabla^2(\rho\vec{u})}{\rho} - \vec{u}\frac{\nabla^2\rho}{\rho}) \tag{5.81}$$

From this we can see the acceleration of the quantum envelope velocity $\vec{u}$, whose dynamics are rooted in the joint contribution of the classical potential and the quantum potential. For the physical state with certain energy, the three-velocity decomposition $\vec{V}(\vec{x}, t) = \vec{u}(\vec{x}, t) + \vec{v}(\vec{x}, t) + \vec{\nu}(t)$ has clear physical meaning. The quantum envelope velocity $\vec{u}(\vec{x}, t)$ and the classical statistical velocity $\vec{v}(\vec{x}, t)$ are both velocity fields, which are functions of space-time coordinates. The classical statistical velocity field of a physical state with certain energy is zero, which can be used as a new interpretation of the steady state of quantum mechanics. The dynamic mechanism of the quantum envelope velocity field $\vec{u}(\vec{x}, t)$ has two contributions, the classical external potential field where the particle is located and the quantum potential field generated by the random collision of time-space. The diffusion velocity $\vec{\nu}(\vec{x}, t)$ is the background of space-time fluctuations, evenly distributed in space, and satisfies the properties of Brownian motion in time, which is the intrinsic property of space-time. The sum of these three velocities is the real velocity of the objective reality of the particles required by materialism. See appendix B where we proved these.With the condition of stationary state $\partial_t \rho = 0$, it goes to

$$\vec{u} = \Re\frac{\nabla\rho}{\rho} \tag{5.82}$$

$$\partial_t \vec{u} = 0 \tag{5.83}$$

It's important to notice that

$$\frac{d\vec{u}}{dt} = \partial_t \vec{u} + (\vec{u} \cdot \nabla)\vec{u} \tag{5.84}$$

The average velocity $\vec{u}$ is not zero in the stationary state, which exactly cancle out its fluctuation velocity. Therefore, given the condition of stationary state, we are able to get

$$-2m\Re^2 \frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}} + V(x) = Const. \tag{5.85}$$

We can prove this constant is exactly the average energy of particle

$$E = \int \rho(\frac{1}{2}mu^2 + V)d^3x \tag{5.86}$$

Now, we have derived

$$-2m\Re^2\frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}} + V(x) \quad = \quad E \tag{5.87}$$

$$\psi \ = \sqrt{\rho}e^{-iEt/\hbar} \tag{5.88}$$

Let $\Re = \frac{\hbar}{2m}$ once again, we arrive at the stationary Schrödinger equation

$$-\frac{\hbar^2\nabla^2}{2m}\psi + V\psi = E\psi \tag{5.89}$$

f) Ground States of Hydrogen Atoms in MIP

In the hydrogen atom system, we can take $\vec{A} = 0$ and $\phi = -\frac{e}{4\pi\epsilon_0 r}$. The stationary solution of the equation (5.56) satisfies

$$E\Psi = \frac{1}{2m}(-i\hbar\nabla)^2\Psi - \frac{e^2}{4\pi\epsilon_0 r}\Psi \tag{5.90}$$

The lowest energy stationary state solution (ground state wave function) is $\Psi(r,\theta,\varphi) = \frac{1}{\sqrt{\pi a^3}}e^{-r/a}$, where $a = 5\times 10^{-11}m$ is the Bohr radius of the hydrogen atom. Using the wave function of the ground state of a hydrogen atom, we can get its quantum envelope velocity as

$$\vec{u} = 2\Re\nabla R = -\frac{\hbar}{ma}\hat{r} = -c\alpha\hat{r} \tag{5.91}$$

Where c is the velocity of light in vacuum, $\hat{r}$ is the unit vector $\hat{r} = \frac{\vec{r}}{r}$. Similarly we can get its classic average velocity

$$\vec{v} = 2\Re\nabla I = 0 \tag{5.92}$$

Its spacetime fluctuation rate is satisfied

$$< \nu_i >= 0, < \nu_i(t)\nu_j(t') >= \Re\delta_{ij}\delta(tt') \tag{5.93}$$

Then the electron in the ground state of the hydrogen atom has its coordinate $\vec{X}(t)$ as a random variable, and its real velocity $\vec{V}$ satisfies the following microscopic dynamic equations.

$$\frac{d\vec{X}(t)}{dt} = \vec{V}(t) = \vec{u} + \vec{v} + \vec{\nu} = -c\alpha\hat{r} + \vec{\nu}(t) \tag{5.94}$$

This is the real equation of motion of the ground state electrons of a hydrogen atom in the context of MIP. The quantum envelope velocity always points to the center of hydrogen atom. The closer to the center, the greater the repulsive force generated by the spacetime potential. Because this envelope velocity is balanced out by the combination of the classical Coulomb potential and the spacetime potential, the hydrogen atom can be stabilized on the ground state.

According to MIP, the real motion of electrons in the ground state of hydrogen atoms, we can calculate the average kinetic energy of electrons as

$$< K >= \frac{m}{2} < \vec{V}(t)^2 >= \frac{m}{2}(c\alpha)^2 + \frac{m}{2} < \vec{\nu}(t)^2 > \tag{5.95}$$

The average of the square of the spacetime fluctuation is

$$< \vec{\nu}(t)^2 >= \Re/T \tag{5.96}$$

Where T is the cumulative interaction time of the electrons. The ground state of a hydrogen atom can exist forever, that is, T tends to infinity, and thus we can obtain the average kinetic energy of the ground state electron as

$$< K >= \frac{m}{2} < \vec{V}(t)^2 >= \frac{m}{2}(c\alpha)^2 \tag{5.97}$$

We can calculate the average potential energy of the electron as

$$< U(r) >=< -\frac{e^2}{4\pi\epsilon_0 r} >=< -\frac{e^2}{4\pi\epsilon_0 a} > \tag{5.98}$$

Where a is the Bohr radius and ϵ_0 is the vacuum permittivity. The average energy of the ground state electrons is the sum of the average kinetic energy and the average potential energy. Substituting the standard values of physical constants, we can get the numerical result of the average energy of the ground state electrons as

$$E =< K > + < U >= -13.6ev \tag{5.99}$$

We have reached the same conclusion as quantum mechanics through the microscopic equation of motion of MIP. It can be seen that quantum mechanics only reflects the statistical average nature of the real motion process and does not reflect all the physics under the framework of MIP.

i. *Deriving the amount of elementary charge from MIP*

According to MIP, the interaction between particles and STP (the basic definition of the action is the product of momentum and displacement)

$$Nh = \oint pdq \tag{5.100}$$

For example, the simplest uniform circular motion is

$$\oint pdq = 2\pi mvr \tag{5.101}$$

Consider the electrons inside the hydrogen atom. STP collisions provide random Brownian motion, and attraction from proton provides centripetal force with equilibrium conditions

$$\frac{e^2}{4\pi\epsilon_0 r^2} = \frac{mv^2}{r} \tag{5.102}$$

The amount of charge can be solved as

$$e = nh\sqrt{\frac{\epsilon_0}{m\pi r}} \tag{5.103}$$

The exact value of the electronic charge can be accurately obtained. We know that in MIP, the exchange action is nh, where n can be any integer.

We only need to make a hypothesis that the orbit of the electron is determined by the quantum number n of STP interaction. The proof of this hypothesis is shown in the next section. That is, when $n = 1$, the electron falls on the Bohr's orbit ($r = 0.53 \times 10^{-10}m$). When $n = 2$, the electrons fall on the second orbit (by analogy). You can get important results (all values below are with international units)

$$h = 6.62 \times 10^{-34}, m = 9.11 \times 10^{-31}, \epsilon_0 = 8.85 \times 10^{-12}$$

After substituting, we obtain the amount of charge as

$$e = 1.6 \times 10^{-19}C \tag{5.104}$$

ii. *Quantum number n of STP determining the orbit of hydrogen atoms*

What we want to prove is that when the electrons are in Bohr's orbit ($r = a$), the amount of exchange action of STP is just a Planck constant, ie

$$h = 2\pi mva \tag{5.105}$$

Using the ground state wave function of the hydrogen atom derived above

$$\psi = \frac{1}{\sqrt{\pi a^3}} e^{-r/a} \tag{5.106}$$

The average value of the momentum can be found as

$$Mv = p = |\int \psi^* (-i\hbar\nabla)\psi d\tau| = \frac{\hbar}{a} \tag{5.107}$$

The integral volume element is $d\tau = r^2 sin\theta d\theta d\varphi dr$ and $h = 2\pi mva$.

iii. *Generalisation to Hydrogen-like atoms*

The exchanged action between particles and STP

$$nh = \oint pdq \tag{5.108}$$

In uniform circular motion

$$\oint pdq = 2\pi mvr \tag{5.109}$$

An electron in a hydrogen-like atom with a positively charged nucleus. STP collisions provide random Brownian motion, and the attraction of the nucleus provides centripetal force with equilibrium conditions

$$\frac{Ze^2}{4\pi\epsilon_0 r^2} = \frac{mv^2}{r} \tag{5.110}$$

The amount of charge can be solved as

$$e = nh\sqrt{\frac{\epsilon_0}{Zm\pi r}} \tag{5.111}$$

The Bohr-like orbital electron corresponding to $n = 1$ has a Bohr radius of $r = a/Z$, from which the elementary charge can be derived as

$$e = 1.6 \times 10^{-19}C \tag{5.112}$$

Starting from MIP, we have made a thorough study of free matter particles and obtained the most important conclusions of quantum mechanics. Furthermore, the most fundamental cause of atomic stability is explained by MIP, and from the first principle we calculate the basic physical quantity of electron charge unit. It can be seen that the random collision of STP does not only provide chaotic background noise , but also the stability of all matter in a seemingly chaotic background. At the most profound level, materialism interpret the physical world and the contradictions are unified.

VII. Quantum Measurement in MIP

a) General Principle

There are fundamental distinctions on quantum measurement between MIP and Copenhagen interpretation. Within the framework of MIP, since matter particle is collided randomly by STP. Any measurement related to position and momentum can not be done in a time interval between two collisions, therefore any this kind of measurement cannot lead to precise result, which means we cannot make errors as small as possible in principle. Therefore, incommutable observables can not only be measured precisely at the same time, but also cannot be measured precisely separately. Theoretically, all measure values means statistical average, which include intrinsic uncertainty from spacetime besides normal measurement errors. For examples, the momentum uncertainty from MIP is due to the statistical properties of fluctuated mass. As a statistical mass, the minimum fluctuation is $\triangle m_{st}$, which roughly is one part per million of electron mass. The position intrinsic uncertainty $\triangle X_{st}$ from MIP is the mean free path between two consecutive collision by STP.

When the spacetime sensible mass is equivalent to the statistical inertial mass, the equation of motion will be determined by Schrödinger equation. In other words, moving matter particle and propagational wave are unified in spacetime. If we want to measure a matter particle, we need apparatus to interact with particle somehow. However, every such measurement has to interrupt the random motion of particle. Therefore, measurement means the end of a Markov process. When the measurement is finished, a new Markov process will begin. For the moving matter particle, the phases of wave functions before and after measurements is completely irrelevant, which cannot interfere each other. Under this framework, it's unnecessary to introduce hypothesises of wave function collapse or multi universe.

b) EPR Paradox in MIP

In a 1935 paper[24], Einstein with Podolsky and Rosen considered an experiment in which two particles that move along the x-axis with coordinates x_1 and x_2 and momenta p_1 and p_2 were somehow produced in an eigenstate of the observables $X = x_1 - x_2$ and $P = p_1 + p_2$ (these two observables commute $[X, P] = 0$).It's easy to understand that the measurement of

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

the position of particle 1 can interfere with its momentum, so that after the second measurement the momentum of particle 1 no longer has a definite value. However two particles are far apart, how can the second measurement interfere with the momentum of particle 2? And if it does not, then after both measurements particle 2 must have both definite position and momentum, contradicting the quantum uncertainty principle. If it does, there exist some "spooky" interaction between two far apart particles, contradicting the locality principle in the special theory of relativity. The orthodox interpretation of quantum mechanics suppose that the second measurement which gives particle 1 a definite position, prevents particle 2 from having a definite momentum, even though the two particles are far apart. The states of the two particles are so call quantum entanglement.

Let's investigate the experimental process in detailed and estimate every uncertainty relations. Suppose two particles that are originally bound in some sort of unstable molecule at rest fly apart freely in opposite directions, with equal and opposite momenta until their separation becomes macroscopically large. Their separation will evolve as

$$x_1 - x_2 = x_{10} - x_{20} + (p_1 - p_2)t/m \tag{6.1}$$

where x_{10}, x_{20} are initial positions of two particles. It's noticed that under MIP, every massive particle is collided randomly by STP, the initial separation of two particle cannot be measured precisely. There exists intrinsic uncertainty $\triangle X_{st} = \triangle|x_{10} - x_{20}|$ as the mean free path between two consecutive collision by STP. According to the uncertainty relation derived from MIP, the momentum difference at least has intrinsic uncertainty as $\triangle P_{st} = \triangle|p_1 - p_2| \geq \frac{\hbar}{\triangle X_{st}}$, because of the commutation $[x_1 - x_2, p_1 - p_2] = 2i\hbar$. Therefore the uncertainty of separation will be

$$\triangle|x_1 - x_2| = \triangle X_{st} + \frac{\hbar t}{\triangle X_{st} m} \tag{6.2}$$

Its minimum is at $\triangle X_{st} = \sqrt{\frac{\hbar t}{m}}$, leading to

$$\triangle|x_1 - x_2| \geq 2\sqrt{\frac{\hbar t}{m}} \tag{6.3}$$

Similarly, the total momentum P is not strictly zero under MIP, which includes at least the intrinsic uncertainty due to

$$\triangle P = \triangle m_{st} v \tag{6.4}$$

where $\triangle m_{st}$is the fluctuation of statistical mass, according to MIP, roughly as one part per million of electron mass. Perform EPR experiment after the second measurement of particle 1, the uncertainty of particle 2 at least will be

$$\triangle p_2 \triangle x_2 = 2\sqrt{\frac{\hbar t}{m}} \triangle m_{st} v \tag{6.5}$$

More importantly , does the intrinsic uncertainty of particle 2 given by MIP contradict the uncertainty relation given by quantum mechanics? If

$$\triangle p_2 \triangle x_2 \leq \frac{\hbar}{2} \tag{6.6}$$

it still contradicts uncertainty relation of quantum mechanics, which means that we will observe the quantum entanglement experimentally, because we have to suppose the "spooky" interaction between two far apart particles to satisfy uncertainty relation. Therefore, we obtain the key criterion of quantum entanglement (momentum-position type) as

$$\frac{\triangle m_{st}^2}{m^2} \leq \frac{\pi \lambda_d}{8L} \tag{6.7}$$

where $\lambda_d = \frac{h}{mv}$ is de Broglie′s wavelength and L is the separation of two particles. So we can conclude that there is a characteristic separation of quantum entanglement as

$$L^* = \frac{\pi \lambda_d}{8} (\frac{m}{\triangle m_{st}})^2 \tag{6.8}$$

When the separation of two particles is larger than L^*, the inequality of (8) cannot be satisfied which means we are no longer able to determine the existence of quantum entanglement from experimental results. The reason is that the intrinsic uncertainty of particle 2 given by MIP has already satisfy uncertainty relation of quantum mechanics automatically. We cannot deduce the existence of 'spooky' interaction in this scenario. For two electrons moving at the speed of $0.01c$, the corresponding characteristic separation will be $L^* \approx 40m$. For two atoms moving at the speed of $0.01c$, the corresponding characteristic separation will be $L^* \approx 4 \times 10^7 m$.

VIII. From MIP to Path Integral

The path integral representation of quantum mechanics is a generalization and formulation method for quantum physics, which extends from the principle of action in classical mechanics. It replaces a single path in classical mechanics with a quantum amplitude that includes the sum or functional integral of all paths between two points. The path integral expression was theoretically published by theoretical physicist Richard Feynman in 1948 [25]. Prior to this, Dirac's 1933 paper[26], had major ideas and some early results. The main advantages of the path integral expression is that it treats spacetime equally, so it is easy to generalize to the theory of relativity, which is widely used in modern quantum field theory. However, the basic assumptions of MIP tell us that the effect of each STP colliding on particles can be seen as an independent path. The weight of each independent path is related to the distribution of energy. This is essentially a process of path integration. To understand this concept more clearly, we consider a simple process as follows. Assuming that the effect of random motion of particles over time Δt is from point A to point B. According to MIP, in this process, the change of the action can only be h, 2h, 3h, ..., but the paths are different corresponding to each specific action change. For example, the smallest amount of action change is one h, corresponding to a linear motion from A to B, and the 2h change corresponds to the movement of the polyline, during which the particle is struck twice by STP, and so on. In this picture, the so-called infrared effect is naturally ruled out, that is, the process of less than one h in Δt. The effect of infinity is also ruled out because the instantaneous velocity has certain upper bound which is the speed of light. We see that under the framework of MIP, the quantum properties of particles are rooted in nature as the statistical description of their random motion.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

a) Path Integral of Free Particle and Spacetime Interaction Coefficient

We had argued the real velocity of free particle in space-time satisfies the decomposition as

$$\vec{V}(\vec{x},t) = \vec{v}(\vec{x},t) + \vec{u}(\vec{x},t) + \vec{\nu}(t) \tag{7.1}$$

in which there are two kinetic arguments, they are classical statistical velocity $\vec{v}$ and quantum envelope velocity $\vec{u}$.

There are two kinetic variables with random motion particle in spacetime, which are classical speed $\vec{v}$ and fluctuated speed $\vec{u}$. The corresponding kinetic equations are

$$\frac{\partial \vec{u}}{\partial t} = -\Re\nabla(\nabla\cdot\vec{v}) - \nabla(\vec{u}\cdot\vec{v}) \tag{7.2}$$

$$\frac{\partial \vec{v}}{\partial t} = -(\vec{v}\cdot\nabla)\vec{v} + (\vec{u}\cdot\nabla)\vec{u} + \Re\nabla^2\vec{u} \tag{7.3}$$

Setting $\Psi = e^{R+iI}$, we are able to linearise as

$$\nabla R = \frac{1}{2\Re}\vec{u} \tag{7.4}$$

$$\nabla I = \frac{1}{2\Re}\vec{v} \tag{7.5}$$

which leads to

$$\frac{\partial \Psi}{\partial t} = i\Re\nabla^2\Psi \tag{7.6}$$

During an infinite small time interval ϵ, the solution can be written in terms of integrals as

$$\Psi(x,t+\epsilon) = \int G(x,y,\epsilon)\Psi(y,t)dy \tag{7.7}$$

which represents the superposition of all the possible paths from y to x. The critical observation of Feynman is the weight factor $G(x,y,\epsilon)$ will be proportional to $e^{iS(x,y,\epsilon)/\hbar}$, where $S(x,y,\epsilon)$ is the classical action of particle as

$$S(x,y,\epsilon) = \int L(x,y,\epsilon)dt = \int (K-U)dt = (\bar{K}-\bar{U})\epsilon \tag{7.8}$$

$\bar{K}$ and $\bar{U}$ are average kinetic energy and potential energy separately. In order to show the equivalence between path integral formulation and the spacetime interacting picture, we should derive our basic kinetic equations from the postulation of path integral $G(x,y,\epsilon) = Ae^{iS(x,y,\epsilon)/\hbar}$. For a free particle in spacetime, one has $\bar{U} = 0, \bar{L} = \frac{m}{2}(\frac{x-y}{\epsilon})^2$ and $S = \frac{m(x-y)^2}{2\epsilon}$, which leads to

$$\Psi(x,t+\epsilon) = A\int e^{\frac{im(x-y)^2}{2\hbar\epsilon}}\Psi(y,t)dy \tag{7.9}$$

Setting $y - x = \xi$ and $\alpha = -\frac{im}{2\hbar\epsilon}$, it can be written in terms of

$$\begin{aligned}\Psi(x,t+\epsilon) &= A\int e^{-\alpha\xi^2}\Psi(x+\xi,t)d\xi \quad (7.10)\\ &= A\int e^{-\alpha\xi^2}(\Psi(x,t)+\xi\frac{\partial\Psi}{\partial x}+\frac{1}{2}\xi^2\frac{\partial^2\Psi}{\partial x^2}+\mathcal{O}(\xi^4))d\xi\end{aligned}$$

With the properties of Gaussian integral

$$\int e^{-\alpha\xi^2}d\xi = \sqrt{\frac{\pi}{\alpha}} \quad (7.11)$$

$$\int e^{-\alpha\xi^2}\xi d\xi = 0 \quad (7.12)$$

$$\int e^{-\alpha\xi^2}\xi^2 d\xi = \frac{1}{2\alpha}\sqrt{\frac{\pi}{\alpha}} \quad (7.13)$$

we can obtain

$$\Psi(x,t+\epsilon) = A(\sqrt{\frac{\pi}{\alpha}}\Psi(x,t)+\frac{1}{4\alpha}\sqrt{\frac{\pi}{\alpha}}\frac{\partial^2\Psi}{\partial x^2}+\mathcal{O}(\alpha^{-\frac{5}{2}})) \quad (7.14)$$

Setting $A=\sqrt{\frac{\alpha}{\pi}}$, we have

$$\Psi(x,t+\epsilon)-\Psi(x,t) = \epsilon\partial_t\Psi(x,t) = \frac{1}{4\alpha}\frac{\partial^2\Psi}{\partial x^2} \quad (7.15)$$

From this integral, We observed that the most important contribution comes from $y-x=\xi\propto\sqrt{\epsilon}$, where the speed of particle is $\frac{y-x}{\epsilon}\propto\sqrt{\frac{\hbar}{m\epsilon}}$, we see here when $\epsilon\to 0$, the speed divergent in order $\sqrt{1/\epsilon}$. The paths involved are, therefore continuous but possess no derivative, which are of a type familiar from study of stochastic process. With the isotropy of space, we have

$$\partial_t\Psi(\vec{x},t) = \frac{1}{4\alpha\epsilon}\nabla^2\Psi(\vec{x},t) \quad (7.16)$$

Corresponding to the Eq. (7.6), if one requires the equivalence between path integral formulation and MIP, there must be

$$i\Re = \frac{1}{4\alpha\epsilon} \quad (7.17)$$

$$\Re = \frac{1}{4i\alpha\epsilon} = \frac{1}{4i(-\frac{im}{2\hbar\epsilon})\epsilon} = \frac{\hbar}{2m} \quad (7.18)$$

Notice that $\Re$ is only an arbitrary parameter in the Eq.(5.31). The consistency between path integral and MIP requires $\Re=\frac{\hbar}{2m}$. An arbitrary finite time interval Δt, can be cut into infinitely many slides of infnitesimal time interval ϵ. And in each ϵ, the collisions leads to many different paths, one can pick one path and consectively another along the time direction, this will end up a path in Δt, sum over all possible paths in Δt gives an integration over path space, which is the celebrated historical summation or path integral. The method here can be straightforwardly generalised to the particle in the external potential as in following section.

b) Path Integral of Particle in an External Potential and Spacetime Interaction Coefficient

In an external potential U, one has $\bar{U} = U(\frac{x+y}{2})$ and $\bar{L} = \frac{m}{2}(\frac{x-y}{\epsilon})^2$, which leads to the action

$$S = \frac{m(x-y)^2}{2\epsilon} - U(\frac{x+y}{2})\epsilon \tag{7.19}$$

According to the path integral formulation, it must satisfy

$$\begin{aligned}\Psi(x,t+\epsilon) &= A\int e^{\frac{im(x-y)^2}{2\hbar\epsilon} - \frac{iU(\frac{x+y}{2})\epsilon}{\hbar}}\Psi(y,t)dy \\ &= A\int e^{\frac{im(x-y)^2}{2\hbar\epsilon}}(1 - \frac{iU(\frac{x+y}{2})\epsilon}{\hbar})\Psi(y,t)dy\end{aligned} \tag{7.20}$$

To the lowest order of ϵ, it shows

$$U(\frac{x+y}{2})\epsilon = U(x+\frac{\xi}{2})\epsilon = U(x)\epsilon \tag{7.21}$$

$$\Psi(x,t+\epsilon) = A\int e^{-\alpha\xi^2}(1 - \frac{iU(x)\epsilon}{\hbar})\Psi(x+\xi,t)d\xi \tag{7.22}$$

From the properties of Gaussian integral in the previous section, we obtain

$$\Psi(x,t+\epsilon) = A(1 - \frac{iU(x)\epsilon}{\hbar})\sqrt{\frac{\pi}{\alpha}}\Psi(x,t) + A\frac{1}{4\alpha}\sqrt{\frac{\pi}{\alpha}}\frac{\partial^2\Psi}{\partial x^2} \tag{7.23}$$

Setting $A = \sqrt{\frac{\alpha}{\pi}}$, $\epsilon \to 0$, we have

$$\partial_t\Psi(\vec{x},t) = \frac{1}{4\alpha\epsilon}\nabla^2\Psi(\vec{x},t) + \frac{1}{i\hbar}U\Psi(\vec{x},t) \tag{7.24}$$

To be consistent with the case of free particle, let's take $\Re = \frac{\hbar}{2m}$ which leads to

$$\partial_t\Psi(\vec{x},t) = i\Re\nabla^2\Psi(\vec{x},t) + \frac{1}{i\hbar}U\Psi(\vec{x},t) \tag{7.25}$$

Therefore we have derived the equation of motion from MIP.

IX. STP Vortices as an Origin of Photon

a) Essential Properties of Electronic Charge In Modern Physics

In framework of modern physic, fundamental matter particles are all electric charged. The fundamental electric charge is defined as the amount of charge of an electron or a positron.

For electric charge [6], there are five fundamental properties. Firstly, there are only two kinds of charges, as known as the positive and negative charges. The characteristic quantum numbers of positron and electron are 1 and -1. Secondly, same charges repel each other, different charges attract each other.Thirdly, the interaction between charges is known as the Coulomb force, obeys the inverse square law. Electron and positron can annihilation each other, emit photons.Forthly, in an isolated system, the algebraic amount of charges are conserved. Finally, the amount of fundamental charge is $1.6 \times 10^{-19}C$.

Since there are no interactions between STP, the differential dynamics of STP is discribed by a massless free scale field theory, its Lagrangian is:

$$\mathcal{L}_{ST} = \partial_\mu \phi \partial^\mu \phi\,. \tag{8.1}$$

The dynamic equation is the 3+1 dimentional Klein-Gordon equation,

$$\partial_\mu \partial^\mu \phi = 0, \tag{8.2}$$

the solution of above equation is a wave solution, it can be written as follow

$$\phi(\vec{x}, t) = \sum_{E^2 = \sum_{i=1}^{3} p_i^2} f(E, \vec{p}) \exp(iEt - i\vec{p} \cdot \vec{x}), \tag{8.3}$$

in which $f(E, \vec{p})$ is an analytic function in momentum space.

Now let us consider putting a particle into space-time. The impact of introducing the matter particle into space-time scalar field, is somehow like dropping a cobble into the water surface of a peaceful lake, leads to the ripple effect. Compare to the fluctuation of space-time, the matter particle introduces a non-perturbative effect, which will bring into the space-time a strong potential. The reason that the matter particle results a strong potential is as follows Any perturbative disturbance will be get drowned out by the fluctuation of microscopic space-time energy fluctuation. In general, strong perturbation will lead to nonlinear effects, especially non-perturbative soliton effect. The soliton effect is steady and relatively large than STP. We know STP are local excitation of space-time energy, obviously, a cluster of STP describes a “huge” excitation of space-time energy. So it is nature to introduce solitons into space-time field since a local non-perturbative energy disturbance leads a local space-time soliton, discribing a cluster effect of STP.

b) 2+1-dim Complex Scalar Space-time field

In modern quantum field theory, the microscopic energy can be non-conserved locally, which is saying the vacuum can excit any pair of virtual conjugated particles. In framework of MIP, the fluctuations of space-time energy are STP. The non-conservation nature of local space-time energy is saying the number of STP are locally non-conserved. However, in a global viewpoint, the energy of STP are conserved.

In framework of MIP, we introduce a local companion for STP field, which is a local field that can interact with STP. Howerver, in global, the companion field will decouple with the STP field. The existence of the local companion field also implies in local there is a kind of local symmetry, which is broken in global. In fact, when the local symmetry is $U(1)$, STP are excitations of a complex scalar field.

In framework of MIP, matter particle experiences Brownian motion, which essentially is a Markov progress. This implies the past and future of the matter particle are causual irrelated. So at an arbitrary point of time, one can cut the slice vertical to the direction of

[6] We will use charge instead of electric charge in this section, for simplicity.

the velocity of the matter particle, as known as the normal slice. The dynamics of matter particle on normal slice is a 2+1-dim dynamics. The whole 3+1-dim dynamics could be extented from the dynamics on slices. Notice there are two kinds of dynamics on the 2+1-dim normal slice, one for matter particle, the other for STP, respectively.

We now consider the 2+1 dimensional dynamics of STP. As is stated above, the matter particle drops a cobble into the STP lake and results a period potential. We denote the potential as $V(\phi, \phi^*)$, thus the Lagrangian of complex STP field now becomes

$$\mathcal{L}_{ST} = -\frac{1}{2}\partial_j\phi\partial^j\phi^* + V(\phi, \phi^*), \quad j = 0, 1, 2. \tag{8.4}$$

c) Abrikosov-Nielsen-Olesen-Zumino Vortex

In 2+1 dimension, the famous non-pertubative solution for a complex scalar field is the Abrikosov-Nielsen-Olesen-Zumino(ANOZ) vortex solution. The Lagrangian supports the ANOZ vortex is

$$\mathcal{L} = -\partial_j\phi^*\partial^j\phi - \frac{\lambda}{2}\left(\phi^*\phi - F^2\right)^2 \tag{8.5}$$

The minimum of the potential is obvious, it is

$$\phi = F \cdot e^{i\varphi}$$

which is a cycle with radius F. Notice this configuration is compatible with the "ripple" effect of matter particle acting on STP field. It also introduces a symmetry $U(1)$. Since this $U(1)$ now is a local symmetry, it implies there should be a gauge field companion with the STP field. The soliton solution is obtained when introducing the boundary condition at infinity, that is

$$|x| \to \infty : \quad \vec{\phi} \to F\frac{\vec{x}}{|x|}, \quad \phi \to Fe^{i\varphi}. \tag{8.6}$$

However, the soliton solition suffers an energy divergence because

$$E = \int d^2x \left(\vec{\partial}\phi^*\vec{\partial}\phi + V(\phi, \phi^*)\right) \tag{8.7}$$

goes to infinity. One can check this as follows

$$\begin{aligned}
|x| \quad &\to \quad \infty : \quad \partial_i\phi_j \to \frac{F}{|x|}\left(\delta_{ij} - \frac{x_i x_j}{|x|^2}\right) \\
\sum_{i,j=1}^{2}(\partial_i\phi_j)^2 \quad &\to \quad \frac{F^2}{|x|^2} \\
\int d^2x\vec{\partial}\phi^*\vec{\partial}\phi \quad &\to \quad 2\pi\int_0^\infty d|x|\frac{F^2}{|x|} : \quad Log \;\; divergent.
\end{aligned} \tag{8.8}$$

We saw the energy of the vortex is divergent at spatial infinity, this is unphysical since it implies there is an infinity energy source at spatial infinity. To avoid this divergence, the way out is to introduce a gauge vector field to smear the infinity energy on whole 2+1-dim normal slice. In fact, the local non-conservation of space-time energy implies we need a companion field for STP field in the first place. Here it is clear that the field is a gauge field. To do so, we need introduce the covariant derivative for STP field, instead of original derivative, as well as a kinetic term for the gauge field. Now the Lagrangian is

$$\mathcal{L} = -\frac{1}{2}D_\mu\phi^* D^\mu\phi - \frac{1}{4}F_{\mu\nu}F^{\mu\nu} - V(\phi,\phi^*) \tag{8.9}$$

$$D_\mu\phi = \partial_\mu - igA_\mu \tag{8.10}$$

The complex STP field degenerates into a real scalar field. This is because the energy non-conservation is recovered in global. The complexity of the STP field reflects the local property of STP. At spatial infinity,

$$\phi \to Fe^{i\varphi}|_{\varphi=0} = F \tag{8.11}$$

the gradient of STP field is

$$\vec{\partial}\phi = (\partial_r\phi\vec{e}_r + \partial_\varphi\phi\vec{e}_\varphi)_{\varphi=0} = iF/r \tag{8.12}$$

and the gauge field becomes pure gauge field (with vanishing field strength), that is

$$\vec{A} \to \frac{1}{ig}\phi^{-1}\vec{\partial}\phi \tag{8.13}$$

In form of polar coordinates,

$$A_r = 0, \quad A_\varphi = \frac{1}{gr} \tag{8.14}$$

In general, we can not let a complex scalar field directly equals to a real scalar field at an arbitrary spatial point. However, we can let them equals to each other up to a gauge transformation, say

$$\phi \to \Omega F, \quad \Omega(\vec{x}) = e^{i\varphi(\vec{x})} \tag{8.15}$$

and then we have

$$\vec{A} \to -\frac{1}{ig}\Omega\vec{\partial}\Omega^{-1} \tag{8.16}$$

Actually, under this general configuration, the divergence of energy will be strictly vanished, as

$$\vec{D}\phi \to \left(\vec{\partial}\Omega + \Omega(\vec{\partial}\Omega^{-1})\Omega\right)F = \Omega\vec{\partial}(\Omega^{-1}\Omega)F = 0 \tag{8.17}$$

In terms of component, the gauge field reads

$$A_i = -\frac{1}{g}\epsilon_{ij}\frac{x_j}{r^2} \tag{8.18}$$

From the Stokes theorem, we have

$$\Phi \equiv \oint_{C=n\cdot\partial\Sigma}\vec{A}d\vec{x} = \int_\Sigma \vec{B}d\vec{\sigma} = \frac{2\pi n}{g} \equiv g_m \tag{8.19}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

here we recognize the famous Dirac quantization condition [9] for electronic charges, say

$$g \cdot g_m = 2\pi n, \quad n \in \mathbb{Z} \tag{8.20}$$

This implies if there was an ANOZ vortex solution, the electronic charge is quantized. When n is a negative integer, it describes an opposite spinning vortex solution and also describes a negative charge. In modern physics, there should be a Dirc monople to support the Dirac quantization condition of charges. In framework of MIP, the only origin of quantized charge is the STP field.

d) From 2+1-d to 3+1-d

In 3+1 Minkowski space-time, the local space-time symmetry is Lorentz symmetry, denoted by $SO(3,1)$. In Lie group theory, $SO(3,1)$ is algebraic isomorphism to $SU(2)\times SU(2)$, that is

$$so(3,1) \cong su(2) \times su(2) \cong so(3) \times so(3). \tag{8.21}$$

In fact, this isomorphism reveals locally, the 3+1-dim space-time equals to cross extension of two 2+1-dim space-time.

Now we consider how this local extension of dimension can be done from Lie algebra. Notice the six generator of Lorentz group can be written explicityly as

$$K_i \equiv L_{0i} = t\partial_i - x_i\partial_t \quad i,j,k \in [1,2,3] \tag{8.22}$$

$$R_k = \epsilon^{ij}{}_k L_{ij} = \epsilon^{ij}{}_k x_i \partial_j \tag{8.23}$$

The two algebra $su(2)$ are isomorphic to $so(3)$, in terms of derivative, they are

$$S_a = \epsilon^{abc} r_a \partial_{r_b} \tag{8.24}$$

$$\tilde{S}_a = \epsilon^{abc} l_a \partial_{l_b} \tag{8.25}$$

in which there are six degrees of freedom, in the meaning of linear space, they are

$$r_1, r_2, r_3, \quad l_1, l_2, l_3$$

Though the Lie algebras of $SO(3,1)$ and $SU(2) \times SU(2)$ is isomorphic to each other, from the viewpoint of degree of freedom, they are not the same. Notice there is a hidden duality, which maps 2-dim surface to 1+1-dim surface and vice versa, as follows

$$\star : e_0 \otimes e_i \to \epsilon_{0i}{}^{jk} e_j \otimes e_k$$

$$\star : e_j \otimes e_k \to \epsilon^{0i}{}_{jk} e_0 \otimes e_i \tag{8.26}$$

This duality is actually the Hodge duality in differential geometry. It implies extension rules should be followed when extending a theory from 2+1-dim to 3+1-dim.

In conclude, we know the rule guiding the extension from 2+1-dim to 3+1-dim is Hodge duality. In the vortex situation considered at hand, the Hodge duality actually corresponds to a resolving of singularity. The vortex has a singular tube which shrinks to a point when goes to its center. If one wants to resolving the singularity, the general way in differential topology is to introduce a finite size sphere instead of the singularity. The resolving operation

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

can be done by two steps: cut the vortex tube at a finite size, which will be a circle, then rotate the circle into a sphere. This rotation was been done in 3+1-dim and is the physical saying of the Hodge duality.

e) The Origin of Photon from ANOZ Vortex

In discussion of ANOZ Vortex, we obtained the gauge constraint and the quantization condition of electric charge, however, we didn't obtain the dynamics of the vortex. Because vortex is not a fundamental excitation, its dynamics can not be analytically achieved from fundamental STPs. So in order to obtain the vortex dynamics. We need to introduce the Lagrangian for vortices.

i. Dynamics on normal slice

For the kinetic part of STPs field, say,

$$\mathcal{L}_\phi = \frac{1}{2}\vec{D}_i\phi^*\vec{D}^i\phi = \frac{1}{2}|(\partial_i - igA_i)\phi|^2 \tag{8.27}$$

in this subsection, $i, j, k, l, m, n = 0, 1, 2$ label indices on the 2+1-dim normal slice. We only consider the excitations nearby the vortex potential, which is $\phi = Fe^{i\varphi}$. The above STP field kinetic Lagrangian can be written as

$$\mathcal{L}_\phi = \frac{1}{2}F^2\left(\partial_i\varphi - gA_i\right)^2 \tag{8.28}$$

After a simple square matching operation, we arrive a linear form

$$\mathcal{L}_\phi = -\frac{1}{2F^2}\xi^i\xi_i + \xi_i(\partial^i\varphi - gA^i) \tag{8.29}$$

here ξ^i is a static auxillary field. Notice that for vortex solution, the phase angle field φ is singular at the vortex center, we now separate the phase angle into two parts, one is smooth and the other is for vortex, say,

$$\varphi = \varphi_0 + \varphi_{vortex} \tag{8.30}$$

The smooth part does not have a significant effect on what we concerned, we integral it out and it results a constraint equation for the auxillary field,

$$\partial_i\xi^i = 0 \tag{8.31}$$

This reveals the auxillary field is a 2+1-dim sourceless field, and it can be rewritten as a pure curl as

$$\xi^i = \epsilon^{ijk}\partial_j a_k \tag{8.32}$$

On the other hand, the equation of motion of auxillary field ξ can also be obtained from Euler-Lagrange equation, it reads

$$\xi^i = F^2(\partial^i\varphi - gA^i) \tag{8.33}$$

The above two equations define a hidden duality as follow

$$F^2(\partial^i\varphi - gA^i) = \epsilon^{ijk}\partial_j a_k \tag{8.34}$$

Substitute it into equation (8.29), we obtain

$$\begin{aligned}\mathcal{L}_\phi &= \frac{1}{2F^2}\xi^i\xi_i = \frac{1}{2F^2}\epsilon^{ijk}\partial_j a_k \epsilon_{imn}\partial^m a^n \\ &= \frac{1}{2F^2}f^{jk}f_{jk}\end{aligned} \tag{8.35}$$

here

$$f_{jk} = \partial_j a_k - \partial_k a_j \tag{8.36}$$

is the field strength of a field. Here we saw the dynamics of the STP field on normal slice is fully equivalent to a vector field a . Recall the kinetic term of gauge field A , we obtain a effective Lagrangian on normal slice

$$\mathcal{L}_{total} = \mathcal{L}_A + \mathcal{L}_\phi = -\frac{1}{4g^2}F^{jk}F_{jk} + \frac{1}{2F^2}f^{jk}f_{jk} \tag{8.37}$$

ii. *The Hodge duality*

Notice in the dynamics of 2+1-dim vortex, the singularity of the phase angle is essential, which results that the corresponding gauge field A is also singular at the center of the vortex. This singularity could be resolved in higher dimension, for example, in 3+1-dim space-time, we can extend the 2+1-dim Hodge duality (8.34) to 3+1-dim. This 3+1-dim Hodge duality reflects the local duality of 3+1-dim Lorentz group, as revealed in last subsection. In 3+1-dim, the complex STPs field becomes real because the phase angle is fixed to zero and has no dynamics at all, leads a free STP scalar field in 3+1-dim. Actually, in 3+1-dim, we can define the Hodge duality of a field as:

$$F'^{\alpha\beta} = \sqrt{2}gFi\epsilon^{\alpha\beta}{}_{ij}f^{ij} \tag{8.38}$$

from which we has defined a gauge field A' , its field strength is

$$F'^{\alpha\beta} = \partial^\alpha A'^\beta - \partial^\beta A'^\alpha \tag{8.39}$$

It is an extension of a field in 3+1-dim and on any 2+1-dim sub-manifold of the 3+1-dim space-time, its dynamics is equivalent to field a . In total, we know

$$\mathcal{L}_{total} = -\frac{1}{4g^2}F^{jk}F_{jk} - \frac{1}{4g^2}F'^{\alpha\beta}F'_{\alpha\beta} \tag{8.40}$$

Actually, in 3+1-dim, the two parts of above Lagrangian can be written as a single term when defined a new field $\tilde{A}$ satisfying

$$\frac{1}{g}\tilde{F}_{ij} = F_{ij}, \quad \frac{1}{g}\tilde{F}_{\alpha\beta} = F'_{\alpha\beta} \tag{8.41}$$

Notice the above equations are six equations, which are

$$\partial_0\tilde{A}_1 - \partial_1\tilde{A}_0 = g(\partial_0 A_1 - \partial_1 A_0) \tag{8.42}$$

$$\partial_0\tilde{A}_2 - \partial_2\tilde{A}_0 = g(\partial_0 A_2 - \partial_2 A_0) \tag{8.43}$$

$$\partial_1\tilde{A}_2 - \partial_2\tilde{A}_1 = g(\partial_1 A_2 - \partial_2 A_1) \tag{8.44}$$

$$\partial_0\tilde{A}_3 - \partial_3\tilde{A}_0 = g(\partial_0 A'_3 - \partial_3 A'_0) \tag{8.45}$$

$$\partial_1\tilde{A}_3 - \partial_3\tilde{A}_1 = g(\partial_1 A'_3 - \partial_3 A'_1) \tag{8.46}$$

$$\partial_2\tilde{A}_3 - \partial_3\tilde{A}_2 = g(\partial_2 A'_3 - \partial_3 A'_2) \tag{8.47}$$

On 0-1-2 normal slice, we can assume

$$\tilde{A}_0|_{\Sigma=(t,x_1,x_2)} = gA_0, \quad \tilde{A}_1|_{\Sigma=(t,x_1,x_2)} = gA_1, \quad \tilde{A}_2|_{\Sigma=(t,x_1,x_2)} = gA_2 \tag{8.48}$$

here $\tilde{A}_i|_{\Sigma=(t,x_1,x_2)}$ denotes the reduced field of the four dimensional gauge field $\tilde{A}$ onto normal slice $\Sigma = (t, x_1, x_2, 0)$. Hence from eq.(8.45-8.47) we see, the constraint equations require that on x_3 direction, $\tilde{A}_0, \tilde{A}_1, \tilde{A}_2$ should coincide with A'_0, A'_1, A'_2 ,

$$A_i(0,0,0,x_3) = A'_i(0,0,0,x_3), \quad i = 0,1,2 \tag{8.49}$$

then we obtain

$$\tilde{A}_3(t,x_1,x_2,x_3) = gA'_3(t,x_1,x_2,x_3) \tag{8.50}$$

Actually, the A'_3 is a new component of the gauge field results from the Hodge duality, it is unique up to a pure gauge with vanishing field strength. Now we see how to extend the gauge field on 2+1-dim to 3+1-dim guiding by the Hodge duality. A simple extension is

$$\tilde{A}_i(t,x_1,x_2,x_3) = g(A_i(t,x_1,x_2,0) + A'_i(0,0,0,x_3)), \quad i = 0,1,2 \tag{8.51}$$

$$\tilde{A}_i(t,x_1,x_2,x_3) = gA'_3(t,x_1,x_2,x_3) \tag{8.52}$$

Under this extension, we arrive a simple Lagrangian

$$\mathcal{L}^{eff}_{3+1d} = -\frac{1}{4}\tilde{F}_{\mu\nu}\tilde{F}^{\mu\nu}, \quad \mu,\nu = 0,1,2,3 \tag{8.53}$$

it is the famous Lagrangian for 3+1-dim gauge field, the field strength is the same as Maxwell field strength. In three dimensional form, the field strength can be written as electric and magnetic field strengths as

$$E_i = \tilde{F}_{0i}, \quad B_i = \epsilon_{ijk}\tilde{F}^{jk}, \quad i,j,k = 1,2,3 \tag{8.54}$$

In above derivation, we saw that the dynamic effects of STP ANOZ vortex and 3+1-dim electromagnetic field are completely equivalent. This reveals an important assertion: photons are companion particles of STP vortices. In 3+1-dim space-time, Maxwell field strength is a derived result because of vanishing of the ANOZ vortex singularity.

In conclusion, when introducing the third spatial dimension, the singularity of ANOZ vortex is vanished. Meanwhile the equation of motion for ANOZ vortices is equivalent to 3+1-dim Maxwell equations, they are

$$\vec{\nabla} \cdot \vec{E} = 0 \tag{8.55}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \tag{8.56}$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \tag{8.57}$$

$$\vec{\nabla} \times \vec{B} = \frac{\partial \vec{E}}{\partial t} \tag{8.58}$$

Here what we obtained is the source-free Maxwell equations because we didn't consider the effect of matter particles, which will couple to gauge field as will considered in next subsection.

f) The Coulomb Force

We now consider the force between two matter particles. In hydrodynamics, two vortices will repel each other if their handing of spins are the same, and will attract each other if their handing of spins are different. This is a nature derivation from Bernoulli principle. There are only two kinds of charity for 2+1-dim vortices, left and right, respectively.

More than two decades ago, people had already found the correspondence between equations of motions of hydrodynamics and Maxwell eletromagenetism [27]. This correspondence was supported by [28] with a detailed derivation. The correspondence between hydrodynamics and eletromagnetism is much more like a coincidence in previous researches. However, in framework of the STP vortex, the fluid-eletromagnetism correspondence now has a concrete theoretic origin.

In previous subsections, we only considered dynamics of STP and gauge fields, leaving the matter particle as a source of potential. It is nature to consider the interaction between matter field and gauge field as well. To do so, we introduce the matter field in Lagrangian as follow

$$\mathcal{L}_{total} = -\frac{1}{4}\tilde{F}_{\mu\nu}\tilde{F}^{\mu\nu} - i\bar{\psi}\gamma^{\mu}\tilde{D}_{\mu}\boldsymbol{\psi} + m\bar{\psi}\psi \tag{8.59}$$

$$\tilde{D}_{\mu} \equiv \partial_{\mu} + ie\tilde{A}_{\mu} \tag{8.60}$$

This interaction can be understood as an effective representation of the collision between matter particle and STP vortices, though their are no terms representing vortices in the Lagrangian. This is because the dynamics of vortices now is equivalent to gauge field in 3+1-dim. Other collisions between matter particle and STP are not considered in this section, as we will see, they also play important roles in deriving gravity between matter particles.

In global, the STP and gauge field are decoupled, hence all local dynamics have been reduced to gauge field dynamics in 3+1-dim space-time. Notice the Lagrangian we obtained above is the same as that in famous QED [29]. Under standard calculation, the interaction between matter particles will be the Coulomb interaction. However, in framework of MIP, the gauge field is not originated from matter field, but from STP vortices. This is an essential difference between modern quantum field theory and the MIP proposed in this article.

Define the four dimensional current as

$$j^{\mu} \equiv i\bar{\psi}\gamma^{\mu}\psi \tag{8.61}$$

we can explicitly see the minimal couple between gauge field $\tilde{A}$ and the electronic current j. The equation of motions now becomes the famous sourced Maxwell equation, as known as

$$\vec{\nabla} \cdot \vec{E} = j_0 \tag{8.62}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \tag{8.63}$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \tag{8.64}$$

$$\vec{\nabla} \times \vec{B} = \vec{j} + \frac{\partial \vec{E}}{\partial t} \tag{8.65}$$

g) *Another Derivation of EoM of Photons*

In framework of MIP, we had obtained four properties of charges, they are: 1. There are only two kinds of charges corresponding to left and right chiralities of STP vortices. Same charges repel each other while different ones attract each other. 2. The charges are quantized guiding by the Dirac quantization condition derived from STP vortex. 3. Force between charges are mediated by photons. 4. The force between charges is the Coulomb force.

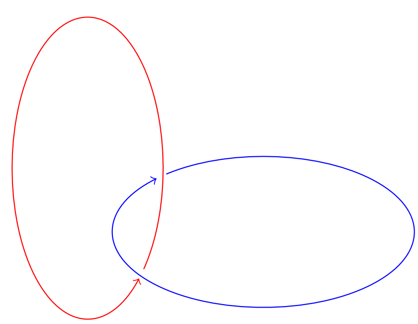


Figure 4: Photon as a topolotical excitation: a Hopf link

Based on calculations in previous subsections and discussion of the Hodge duality, we know some properties of phtons in frame work of MIP. At first, it companies with the non-pertubative solition solution, as known as the vortex solution. Secondly, it is a gauge field in 2+1-dim normal slice on which another effective auxillary gauge field lives as well. Thirdly, the 3+1-dim Hodge duality acts on the effective auxillary gauge field does not only resolve the phase singularity of the STP vortex, it introduces the dual part of 2+1-dim gauge field. So the 2+1-dim gauge field and its Hodge dual merged into a 3+1-dim gauge field, which is the photon field, which means on 3+1-dim space-time, the photon field can be understood as toplogical excitations of 2+1-dim gauge field, the topological configuration is known as the Hopf link excitation. We now clarify the conclusion in detail since it is very important to understand the spin of photon, which has a zero mass.

In framework of STP vortex, the vortex tube is made of two fields, one is the STP field ϕ , whose gradient defines the flow direction of the vortex, the other is 2+1-dim gauge field A whose field strength characterizes the spinning direction of the vortex. So in this picture, A describes the rotation and ϕ the flowing. Under the Hodge duality, the dynamics of the soliton part of STP field is equivalent to another gauge field A' , which is Hodge dual to A. Topologically, the vortex tube reprensents a Wilson loop, its Hodge duality is t'Hooft loop. Put them together forms a famous topological object, the Hopf link, as shown in Fig.4. The Hopf link is obvious a non-local object. The topological stability of the Hopf link protects it from pertubative destruction, so it can propagate in space-time without dissipation unless it meets another vortex. This is very similar to what happens in electromegnatic interaction, where photons propagates the interaction between charges. We had seen the equation of motion of the $\tilde{A}$, aka the joint representation of A and A' , is nothing but the Maxwell equations. The $\tilde{A}$ field is an effective representation of the Hopf link.

There are two circles in a Hopf link, they wind the topological subgroup (mathematically, the minimal torus) of Lorentz group separately. As we knew in previous section, they are left and right hand topological circles, each corresponds to a spinor fiber. However, in physics, there are no purely topological objects. So we need to consider the dynamics of the Hopf link, say, the effect resulted from deformation of either circle.

Consider an arbitrary deformation on one of the two circles, it will affect the whole Hopf link and defines a self isomorphism as follow

$$A : \Lambda_L \otimes \Lambda_R \to \Lambda_L \otimes \Lambda_R \tag{8.66}$$

here A denotes the self isomorphism on $\Lambda_L \otimes \Lambda_R$, Λ_L and Λ_R are left and right spinor firbers respectively. In appendix E, we proved that such a self isomorphism should be a vector map. Relatively, all derivatives should be changed into covariant derivatives, as

$$\partial_\mu \to D_\mu = \partial_\mu + igA_\mu \tag{8.67}$$

This leads to non-trivial local transmition that

$$[D_\mu, D_\nu] = D_\mu D_\nu - D_\nu D_\mu = ig(\partial_\mu A_\nu - \partial_\nu A_\mu). \tag{8.68}$$

This reflects the local homomorphism deformation. The strength of the deformation is described by the coefficient g, which relates to charge of matter particle. So we could propose an assertion: the amount of electric charge reflects the strength of local deformation of local space-time. The RHS of above equation is nothing but a field strength of four dimensional gauge field

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu \tag{8.69}$$

Since

$$\begin{aligned} D^\mu[D_\mu, D_\nu] &= ig\partial^\mu(\partial_\mu A_\nu - \partial_\nu A_\mu) - g^2 A^\mu(\partial_\mu A_\nu - \partial_\nu A_\mu) \\ &= -ig\Box A_\nu + ig\partial_\nu(\partial^\mu A_\mu) - g^2\partial_\mu(A^\mu A_\nu) + g^2(\partial_\mu A^\mu)A_\nu \\ &= \frac{1}{2}g^2\partial_\nu(A_\mu A^\mu) \end{aligned} \tag{8.70}$$

under Lorentz gauge $\partial_\mu A^\mu = 0$,the above equation only have pure derivation contributions, with vanishing contributions for no-boundary free field. So this equation can be simply written as

$$D^\mu F_{\mu\nu} = 0 \tag{8.71}$$

In three dimensional form, it can be written as

$$\vec{\nabla} \cdot \vec{E} = 0 \tag{8.72}$$

$$\partial_t E - \vec{\nabla} \times \vec{B} = 0 \tag{8.73}$$

In another way, because the Hopf link configuration is unchanged under left-right flop symmetry, this leads to a electromagnetic duality for field strength $F_{\mu\nu}$. The left-right flop symmetry actually means a flop between pair of indices $(0, i) \leftrightarrow (j, k)$, this can be achieved by introducing the Levi-Cevita connection

$$\epsilon^{0ijk} : (0, i) \to (j, k) \tag{8.74}$$

thus for the field strength $F_{\mu\nu}$, we have the following dual relation

$$\tilde{F}_{\alpha\beta} \equiv \frac{1}{2}\epsilon_{\mu\nu\alpha\beta}F^{\mu\nu} \tag{8.75}$$

The Levi-Cevita connection flip electric and magnetic fields in three dimensions, and the above dual relation reads

$$\vec{E} \to \vec{B}, \quad \vec{B} \to -\vec{E} \tag{8.76}$$

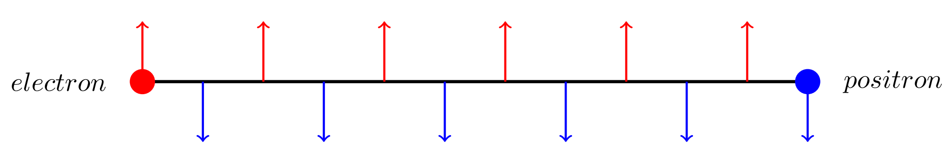


Figure 5: Photons deliver the interaction between electron and positron

The dual equation in four dimensional is written as

$$D_\mu \tilde{F}^{\mu\nu} = 0 \tag{8.77}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

In three dimension, it becomes two equations

$$\vec{\nabla}\cdot\vec{B} = 0 \tag{8.78}$$

$$\partial_t\vec{B} - \vec{\nabla}\times\vec{E} = 0 \tag{8.79}$$

Equations (8.72,8.73,8.78,8.79) are Maxwell equations for source-free electromagnetic fields, which proves in 3+1-dim, the Hopf link transforms the local deformation just the same as photon propagates in space-time.

The figure fig.5 shows how a deformation propagates from an electron to a positron, where red upper arrows denote left topological circles and blue downer arrows denote right topological circles.

h) Photon and vortex tube

We had already known that in framework of MIP, the spins of matter particles are originated from collisions between them and STP along topological circles in local space-time. Now we knew the photon could be represented as a Hopf link, which also is winding topological circles in 3+1-dim local space-time. So it is possible the spin of photons are also originated from STP.

In case of matter particles, for examples, electron and positron, their spins are sourced from local winding along left and right topological circles $U(1)_L$ and $U(1)_R$ in local space-time, respectively. At arbitrary moment, electron or positron has a phase angle φ_L or φ_R. These two phase angles are undetermined. It means electron or positron has a local phase angle symmetry, which is $U(1)$ symmetry. Because it is deduced from local space-time symmetry, it is a gauge symmetry.

Let us choose the phase angle be θ . The identical principle for fundamental particles requests the following equations

$$\boldsymbol{\psi} \to \psi e^{-i\varphi_L} \equiv \psi e^{-i\theta}, \quad \bar{\boldsymbol{\psi}} \to \bar{\psi} e^{-i\varphi_R} \equiv \psi e^{i\theta} \tag{8.80}$$

from which we know

$$\varphi_L = -\varphi_R = \theta \tag{8.81}$$

It means the gauge group $U(1)$ is the diagonal subgroup of $U(1)_L \times U(1)_R$, with transition matrix be -1. This perspective could be extend to higher dimensional transition matrices, which will leads to non-Abelian gauge groups, for example, $SU(2)$ or $SU(3)$.

In this picture, photon is represented as a Hopf link of 2+1-dim gauge fields, it is massless. However, it carries the information of collisions between matter particle and STP vortices. So it will also record the motion of the matter particle, as well as its spin. Since it is a $(1,1)$ representation of the topological subgroup of Lorentz group. Therefore, from the Hopf link proposition, we obtained photon has spin 1, and massless, and satisfies Maxwell equations. It actually explains how a massless photon has non-zero spin.

i) The generation of charged leptons in MIP

In the frame of MIP, there are no more than 3 generations of charged leptons.

According to MIP, the mass of matter particles is a statistical mass deriving from collision of STP. This collision effects of STP can be described by an effective potential $V(x)$,which reflects the strength of the interactions between STP and matter particles and will vary with the statistical mass: the bigger the statistical mass, the stronger effective potential you will get. If the particle is massless, there is no collision. Therefore the space is homogeneous and isotropic so that we can write $V(x) = 0$. On the other hand the previous discussion has shown us that the 3+1-dimensional electromagnetic field is born in vortex solution in 2+1-dimensional spacetime.

In the following we will make a study of the number of generations of charged leptons in the Standard Model, which is still an open question. Crossing any point O in 3-dimensional space there are 3 independent orthogonal 2-dimensional planes. Take O as the origin and choose rectangular coordinate system with the coordinates (x^0, x^1, x^2, x^3) . The Lagrangian equipped with vortex solution in the 2+1-dimensional subspaces can take the following forms

$$L_a^{2+1} = \partial_\mu \phi^* \partial^\mu \phi - \frac{\lambda_a}{2}\left(\phi\phi^* - F^2\right)^2, \tag{8.82}$$

with $a = 1, 2, 3$ respectively corresponding to 3-dimensional spacetime:

$$(x^0, x^2, x^3),\ (x^0, x^1, x^3),\ (x^0, x^1, x^2),$$

λ_a is the coupling constant which reflects the strength of the effective potential and is closely related to the statistical mass of the particle. If $\lambda_a = 0$, that is $V(x) = 0$, indicating the particle is massless ,there is neither collision nor vortex solution. So the statistical mass is an essential prerequisite for a particle to get charge. Following the steps in the previous section, bring in the gauge field $\vec{A}$ and investigate the excited states near the lowest point of the potential. From (8.27), we get

$$L_a^{2+1} = L_{\bar{A}} + L_\phi = -\frac{1}{4}F_{ij}F^{ij} + \frac{1}{4}f_{ij}f^{ij}, \tag{8.83}$$

with (i, j) taking values in the corresponding subspace. For the sake of simplicity, we have chosen the coupling constants of the gauge fields to be 1. Now the Lagrangians do not obviously involve λ_a any more and therefore have nothing to do with the statistical mass of the particle. Take Hodge $*$ duality, and lift the 2+1-dimensional theory to 3+1-dimensional spacetime. We take the notation $F_{\alpha\beta} = i\epsilon^{ij}_{\alpha\beta} f_{ij}$. For L_1^{2+1},

$$L_1^{2+1} = -\frac{1}{4}F_{ij}F^{ij} + \frac{1}{4}f_{ij}f^{ij} \tag{8.84}$$

Here the indexes i, j come from the subspace (x^0, x^2, x^3), with $i, j = 0, 2, 3$. The independent components of the field strength are $F_{02}, F_{03}, F_{23}, f_{02}, f_{03}, f_{23}$. and

$$\begin{cases} F_{\alpha\beta} = i\epsilon^{02}_{\alpha\beta} f_{02} \Rightarrow F_{13} = -if_{02} \\ F_{\alpha\beta} = i\epsilon^{03}_{\alpha\beta} f_{03} \Rightarrow F_{12} = if_{03} \\ F_{\alpha\beta} = i\epsilon^{23}_{\alpha\beta} f_{23} \Rightarrow F_{01} = -if_{23} \end{cases} \tag{8.85}$$

Here we take the usual notations as $g_{\mu\nu} = \mathrm{diag}(1,-1,-1,-1)$, $\epsilon^{0123} = 1$. So that for L_1^{2+1} in the 3+1-dimensional spacetime, we have

$$L_1^{3+1} = -\frac{1}{4}\tilde{F}_{\mu\nu}\tilde{F}^{\mu\nu} = -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} + \frac{1}{4}\tilde{F}_{\alpha\beta}\tilde{F}^{\alpha\beta}$$

$$= -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} - \frac{1}{4}\tilde{f}_{ij}\tilde{f}^{ij} \tag{8.86}$$

with

$$\tilde{F}_{\mu\nu} = \begin{pmatrix} 0 & -i\tilde{f}_{23} & \tilde{F}_{02} & \tilde{F}_{03} \\ i\tilde{f}_{23} & 0 & i\tilde{f}_{03} & -i\tilde{f}_{02} \\ -\tilde{F}_{02} & -i\tilde{f}_{03} & 0 & \tilde{F}_{23} \\ -\tilde{F}_{03} & i\tilde{f}_{02} & -\tilde{F}_{23} & 0 \end{pmatrix} \tag{8.87}$$

Following the same way, for L_2^{2+1} , we get

$$F_{\alpha\beta} = i\epsilon^{ij}_{\alpha\beta} f_{ij} \Rightarrow \begin{cases} F_{\alpha\beta} = i\epsilon^{01}_{\alpha\beta} f_{01} \Rightarrow F_{23} = if_{01} \\ F_{\alpha\beta} = i\epsilon^{03}_{\alpha\beta} f_{03} \Rightarrow F_{12} = if_{03} \\ F_{\alpha\beta} = i\epsilon^{13}_{\alpha\beta} f_{13} \Rightarrow F_{02} = if_{13} \end{cases} \tag{8.88}$$

$$L_2^{3+1} = -\frac{1}{4}\tilde{F}_{\mu\nu}\tilde{F}^{\mu\nu} = -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} + \frac{1}{4}\tilde{F}_{\alpha\beta}\tilde{F}^{\alpha\beta}$$

$$= -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} - \frac{1}{4}\tilde{f}_{ij}\tilde{f}^{ij} \tag{8.89}$$

with

$$\tilde{F}_{\mu\nu} = \begin{pmatrix} 0 & \tilde{F}_{01} & i\tilde{f}_{13} & \tilde{F}_{03} \\ -\tilde{F}_{01} & 0 & i\tilde{f}_{03} & \tilde{F}_{13} \\ -i\tilde{f}_{13} & -i\tilde{f}_{03} & 0 & i\tilde{f}_{01} \\ -\tilde{F}_{03} & -\tilde{F}_{13} & -i\tilde{f}_{01} & 0 \end{pmatrix}. \tag{8.90}$$

For L_3^{2+1} , we can obtain

$$F_{\alpha\beta} = i\epsilon^{ij}_{\alpha\beta} f_{ij} \Rightarrow \begin{cases} F_{\alpha\beta} = i\epsilon^{01}_{\alpha\beta} f_{01} \Rightarrow F_{23} = if_{01} \\ F_{\alpha\beta} = i\epsilon^{02}_{\alpha\beta} f_{02} \Rightarrow F_{13} = -if_{02} \\ F_{\alpha\beta} = i\epsilon^{12}_{\alpha\beta} f_{12} \Rightarrow F_{03} = -if_{12} \end{cases} \tag{8.91}$$

$$L_3^{3+1} = -\frac{1}{4}\tilde{F}_{\mu\nu}\tilde{F}^{\mu\nu} = -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} + \frac{1}{4}\tilde{F}_{\alpha\beta}\tilde{F}^{\alpha\beta}$$

$$= -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} - \frac{1}{4}\tilde{f}_{ij}\tilde{f}^{ij} \tag{8.92}$$

with

$$\tilde{F}_{\mu\nu} = \begin{pmatrix} 0 & \tilde{F}_{01} & \tilde{F}_{02} & -i\tilde{f}_{12} \\ -\tilde{F}_{01} & 0 & \tilde{F}_{12} & -i\tilde{f}_{02} \\ -\tilde{F}_{02} & -\tilde{F}_{12} & 0 & i\tilde{f}_{01} \\ i\tilde{f}_{12} & i\tilde{f}_{02} & -i\tilde{f}_{01} & 0 \end{pmatrix}. \tag{8.93}$$

According to the above, starting with 3 different 2+1-dimensional Lagrangians L_a^{2+1}, we end up with the 3+1-dimensional Lagrangians which have the uniform description as

$$L_a^{3+1} = -\frac{1}{4}\tilde{F}_{\mu\nu}\tilde{F}^{\mu\nu} = -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} + \frac{1}{4}\tilde{F}_{\alpha\beta}\tilde{F}^{\alpha\beta}$$

$$= -\frac{1}{4}\tilde{F}_{ij}\tilde{F}^{ij} - \frac{1}{4}\tilde{f}_{ij}\tilde{f}^{ij}\ . \tag{8.94}$$

In fact they are the same one since they can be converted to each other by rotating the proper coordinate axis as follows

$$L_1^{3+1} \quad (\hat{e}_1 \leftrightarrow \hat{e}_2) \to L_2^{3+1} \quad (\hat{e}_2 \leftrightarrow \hat{e}_3) \to L_3^{3+1}, \tag{8.95}$$

which is equivalent to internal rotations of the gauge fields $\vec{A}, \vec{a}$. For the electromagnetic field arising from the lepton with fundamental charge in 3+1-dimensional spacetime, when we trace back to its birth in 2+1-dimensional subspace, we will find out we have 3 degrees of freedom described by $\lambda_a,\ a = 1, 2, 3$, and just corresponding to the 3 different subspaces. Therefore the type of charged leptons is no more than 3. Actually the modern science has told us there are 3 generations of charged leptons in our real world, which is just in accordance with $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq 0$ in our framework and from the aspect of STP the local isotropy of spacetime is broken. In conclusion, in the frame of MIP, there are no more than 3 generations of charged leptons, which is firmly rooted in the fact that we live in a 3+1dimensional spacetime.

j) Conclusion of the section

In this section, from the MIP picture, we explained the origin of electromagnetic interaction in detail. In framework of MIP, the 3+1-dim electromagnetic field represents itself as a Hopf link exicitation made of 2+1-dim gauge field and its Hodge dual partner. It is a topological state. From this topological configuration, we obtained the Maxwell equations in two different ways, also from which, we explained why massless photons have spin 1. In this section, we studied four properties of electric charges, say, positive and negative, quantization, repelling and attracting , Coulomb inverse square law ,and equations of motions of photons, which propagates the Coulomb interaction between charged particles. In addition, together with the charge amount calculated in section 5, we obtained all five properties of the electric charge.

There is one additional expression for the STP vortex configuration.In this section, we only considered the non-pertubative potential came from matter particle. However, a non-pertubative disturbance of space-time energy does not only have such a single origin in our universe. In early universe, the disturbance is very large and STP vortices could also be generated as well as its partner field, the photon field. It implies in early time, the universe was dominated by radiation, which coincides with observations in cosmology. Another example for non-pertubative potential is black holes, near the horizon of a black hole, the space-time energy disturbance is quite large, and it will also generate electromagnetic radiation. This kind of radiation has a completely different origin comparing with Hawking radiation. This may offer quite a lot of new perspectives on black hole and cosmology researches.

Last and most importantly, we derived the generation for charged leptons. This is a completely new result and one can not derive this law in current quantum field theory framework. Within the MIP framework, by invoking the STP vortices, the generation is a direct inference.

X. Radiation of Charged Particles in the MIP Framework

In classical physics, there is an obvious difficulty from the stable existence of atoms. According to Maxwell's electromagnetic theory, accelerated electrons radiate energy in the form of electromagnetic waves. The electrons orbiting the nucleus are constantly accelerating, so the orbiting electrons should continue to radiate energy, causing the electrons to spiral into the nucleus, and stable atoms will cease to exist.

Bohr broke the law of classical physics by postulating that electrons do not emit photons as they accelerate around the nucleus. Radiation occurs only when electrons transition from a higher energy level to a lower energy level. More than a hundred years since Bohr model, the original difficult question still exists: Why don't electrons radiate photons when they orbit in hydrogen atoms? According to classical electrodynamics, accelerating electrons will radiate electromagnetic waves, resulting in continuous loss of energy. However, the Bohr model cannot explain why electrons in a stationary state do not emit electromagnetic radiation.

Although the Bohr model was only the initial attempt of quantum mechanics, this difficult issue was also covered up in the Copenhagen interpretation after the mature development of quantum mechanics. Copenhagen interpretation's answer to this question contains several interrelated but not completely unified guidelines:

1. Wave-particle duality. When an electron is detected by an experimental instrument, it is a localized particle. When experimental instruments do not detect electrons, electrons are non-local waves. Therefore one cannot talk about the speed and acceleration of electrons.

2. The probability wave from Born's rule is also an important part of Copenhagen interpretation, which believes that the waves in the wave-particle duality are not real fluctuations, but fluctuations of probability amplitude. If it is a physical wave, then the charge will have a distribution in space. However, experiments have proved that the charge is quantized and always localized.

3. Uncertainty relationships. An electron cannot have a definite velocity and coordinates at the same time. Therefore, electrons do not have a trajectory, so the radiation predicted by classical electrodynamics is out of the question.

The above views were originally just the opinions of the Copenhagen school, but later gradually evolved into the mainstream interpretation in the physics community. This interpretation does not really solve the problem of orbiting electronsin hydrogen atoms and not emitting photons from first principles. According to the MIP proposed in this article, the trajectory of electrons in hydrogen atoms is real, which has real physical coordinates and speeds. As a real object, electrons move locally in atoms and cannot maintain a state of linear and uniform motion, so they must have acceleration. How to make electrons accelerate without radiating at the same time is the core issue of this chapter.

a) Radiation of free charged particles

Let's first look at the electromagnetic field generated by an arbitrary moving point charge a

$$\phi = \frac{e}{R(1-\frac{\vec{v}\cdot\hat{\vec{n}}}{c})} \tag{9.1}$$

$$\vec{A} = \frac{e\vec{v}}{cR(1-\frac{\vec{v}\cdot\hat{\vec{n}}}{c})} \tag{9.2}$$

Where $\vec{R} = R\hat{\vec{n}}$ is the radial vector from the point where the charge is located to the observation point, and $\vec{v}$ is the speed of the charged particle. If it is a free electron performing Brownian motion, the random collision of STP is isotropic. In the MIP framework, the average number of STP collisions with electrons within one second is about 10^{20} times. In other words, the typical time scale discussed in the theory derived from MIP is 10^{-20} seconds. The interval between collisions is extremely short. Within the experimentally measurable time interval $\triangle t$, the average speed and average acceleration of charged free particles are zero

$$<\vec{v}>=0 \tag{9.3}$$

$$<\dot{\vec{v}}>=0 \tag{9.4}$$

Below we denote the radial probability distribution of free electrons in velocity space as $\rho_f(v)$. Its angular distribution is spherically symmetric, which is different from the probability distribution ρ_b of the bound state. Note that the time of experimental observation is t, and the time when radiation occurs is t', and the two satisfy $t' + \frac{R(t')}{c} = t$. With $10^{-20}s \ll \triangle t \ll t - t'$, the displacement of charged particles caused by a single STP collision is much smaller than R, therefore the displacement of the electron within the time interval $\triangle t$ and the time difference of a single collision can be ignored, that is, multiple collisions within the time interval $\triangle t$ are considered to occur simultaneously. According to the definition of electromagnetic field

$$\vec{E} = -\frac{1}{c}\frac{\partial\vec{A}}{\partial t} - \nabla\phi \tag{9.5}$$

$$\vec{B} = \hat{\vec{n}} \times \vec{E} \tag{9.6}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

The radiated electric field generated by an arbitrary moving point charge is

$$\vec{E} = \frac{e}{c^2 R(1 - \frac{\vec{v}\cdot\hat{\vec{n}}}{c})^3}\hat{\vec{n}} \times ((\hat{\vec{n}} - \frac{\vec{v}}{c}) \times \dot{\vec{v}}) \tag{9.7}$$

The corresponding radiated magnetic field is

$$\vec{B} = \hat{\vec{n}} \times \vec{E} \tag{9.8}$$

Due to the spherical symmetry of the probability distribution, without loss of generality, taking the z axis along the direction of $\hat{\vec{n}}$, we can write down the radiated electromagnetic field in spherical coordinates as

$$\vec{E} = \frac{e}{c^2 R(1 - \frac{v\cos\theta}{c})^3}\{\frac{d}{dt'}(\frac{v}{c}\cos\theta)(v\sin\theta\cos\phi\hat{e_x} + v\sin\theta\sin\phi\hat{e_y}) \tag{9.9}$$

$$-(1 - \frac{v}{c}\cos\theta)\frac{d}{dt'}(v\sin\theta\cos\phi\hat{e_x} + v\sin\theta\sin\widehat{\phi e_y})\}$$

$$\vec{B} = \frac{e}{c^3 R(1 - \frac{v\cos\theta}{c})^3}\{\frac{d}{dt'}(\frac{v}{c}\cos\theta))(v\sin\theta\cos\phi\hat{e_y} - v\sin\theta\sin\phi\hat{e_x}) \tag{9.10}$$

$$-(1 - v\cos\theta)\frac{d}{dt'}(v\sin\theta\cos\phi\hat{e_y} - v\sin\theta\sin\ \widehat{phie_x})\}$$

Therefore, the statistical average collision effect of STP within $\triangle t$ is

$$< \vec{E} >= \frac{1}{4\pi}\int_0^{\pi}\sin\theta d\theta\int_0^{2\pi}d\phi\int dv\vec{E}\rho_f(v) \tag{9.11}$$

$$< \vec{B} >= \frac{1}{4\pi}\int_0^{\pi}\sin\theta d\theta\int_0^{2\pi}d\phi\int dv\vec{B}\rho_f(v) \tag{9.12}$$

where $\rho_f(v)$ is the velocity distribution function of Brownian motion independent of time, that is, we have

$$< \frac{\frac{d}{dt'}(v\sin\theta\sin\phi\hat{e}_x - v\sin\theta\cos\phi\hat{e}_y)}{(1 - \frac{v}{c}\cos\theta)^2} >= \frac{d}{dt'} < \frac{(v\sin\theta\sin\phi\hat{e}_x - v\sin\theta\cos\phi\hat{e}_y)}{(1 - \frac{v}{c}\cos\theta)^2} > \tag{9.13}$$

Therefore we can get

$$< \vec{E} >=< \vec{B} >= 0 \tag{9.14}$$

We have proved that free electrons do not radiate electromagnetic waves when performing Brownian motion. The electromagnetic field generated by a single collision in STP is magically canceled due to the existence of spherical symmetry of the probability distribution! The above proof has two important meanings:

1. In the Copenhagen interpretation, free particles are not moving in a straight line at a uniform speed, because uniform straight line motion has well defined trajectory, that is having well defined momentum and position at every moment. In other words, Copenhagen interpretation itself cannot prove that free electrons do not emit photons.

2. Maxwell's electromagnetic theory still holds true in the microscopic world. Only by combining electromagnetic theory with Brownian motion, the preposition that free electrons do not emit photons can be proved. It is this combination that provides the objective reality picture of quantum mechanics.

b) Radiation of charged particles in bound state

Now let's study electrons in the hydrogen atom as an example. We investigate the most important case first, where the hydrogen atom is in its lowest energy state (the ground state). When the electrons are in the ground state, it takes about 1.5×10^{-15} seconds for the electrons to orbit the nucleus. This time scale is still five orders of magnitude larger than the time scale of STP collisions. Therefore, the collision time interval is extremely short, and the assumption in the previous section that multiple collisions occur simultaneously still holds. For a stationary hydrogen atom, the wave function of the electron bound state is

$$_{nlm}(r,\theta,\phi) = R_{nl}(r)Y_{lm}(\theta,\phi) \tag{9.15}$$

The probability distribution of the radial position of the electron, that is, regardless of the direction, the probability of finding an electron in the spherical shell $(r, r+dr)$ is

$$r^2 dr \int d\Omega |\psi_{nlm}|^2 = \int \chi_{nl}^2(r)dr \tag{9.16}$$

The probability of an electron depending on the angle is

$$|Y_{lm}(\theta,\phi)|^2 d\Omega \propto |P_l^m(\cos\theta)|^2 d\Omega \tag{9.17}$$

The distribution of electrons in the ground state of the hydrogen atom is a spherically symmetric function, that is, the distribution function $Y_0^0(\theta,\varphi)$ has nothing to do with the spherical coordinate angles θ and φ

$$Y_0^0(\theta,\varphi) = \sqrt{\frac{1}{4\pi}} \tag{9.18}$$

It should be noted that although the Hamiltonian of the hydrogen atom system has spherical symmetry, only the electron distribution of the S state preserve this symmetry. This proof is actually universal and applies to S states of any energy level ($l = 0$ is called S state), such as 1S, 2S, 3S, etc. The distribution of electrons in hydrogen atoms in any S state is a spherically symmetric function. There is also a distribution function $Y_0^0(\theta,\varphi)$ that has nothing to do with the spherical coordinate angles θ and φ. Through the Fourier transform, we can find the wave function in the momentum space

$$\Upsilon_{nlm}(P,\Theta,\Phi) = \left\{\frac{1}{\sqrt{2\pi}}e^{\pm im\Phi}\right\}\left\{\sqrt{\frac{(2l+1)(l-m)!}{2(l+m)!}}P_l^m(\cos\Theta)\right\} \tag{9.19}$$

$$\times\left\{\frac{\pi 2^{2l+4}l!}{(\gamma h)^{3/2}}\sqrt{\frac{n(n-l-1)!}{(n+l)!}}\frac{\zeta^l}{(\zeta^2+1)^{l+2}}C_{n-l-1}^{l+1}(\frac{\zeta^2-1}{\zeta^2+1})\right\}$$

Where $\gamma = \frac{Z}{na_0}$, $\xi = \frac{P}{\hbar\gamma}$, a_0 is the Bohr radius. For the hydrogen atom $Z = 1$, the probability density of the momentum space is $\rho_{nlm} = |\Upsilon_{nlm}(P, \Theta, \Phi)|^2$. For any S state, the probability density of momentum space simplifies to

$$\rho_{n00} = |\Upsilon_{n00}(P, \Theta, \Phi)|^2 = \rho_{n00}(P) \tag{9.20}$$

It can be seen that in any S state, the probability distribution of momentum space is spherically symmetric. The probability density of the velocity space $\rho_b(v)$ can be obtained through $P = mv$. Because the angular distribution of this probability is spherically symmetrical, it can be obtained with the same method in the previous section

$$< \vec{E} >= \int_0^{\pi} \sin\theta d\theta \int_0^{2\pi} d\phi |Y_0^0(\theta, \varphi)|^2 \int_0^{\infty} dv \vec{E} \rho_b(v) = 0 \tag{9.21}$$

$$< \vec{B} >= \int_0^{\pi} \sin\theta d\theta \int_0^{2\pi} d\phi |Y_0^0(\theta, \varphi)|^2 \int_0^{\infty} dv \vec{B} \rho_b(v) = 0 \tag{9.22}$$

Where leads to an important conclusion: the electrons in the ground state do not radiate photons, which guarantee the stability of the ground state. The electrons will not continuously radiate photons and eventually fall into the nucleus.

Therefore, we have proved that the bound charged particles do not radiate electromagnetic fields in any S state. From the perspective of classical physics, the electrons in hydrogen atoms are interacting with a centripetal force and must move in a plane, so it is impossible to have a spherically symmetrical distribution. It is the random collision of STP that causes electrons to be distributed on the spherical surface with equal probability, and they can move back and forth between different spherical surfaces. Within the framework of MIP, the existence of any S state of electrons in hydrogen atoms is precisely the objective proof of STP.

For stationary states other than the S state, the probability density of the electron momentum space is $\rho_{nlm} = |\Upsilon_{nlm}(P, \Theta, \Phi)|^2 = \rho_{nlm}(P, \Theta)$, the probability density of the velocity space $\rho_b(v, \Theta)$ can be obtained through $P = mv$. It can be seen that due to the existence of angular momentum, the spherical symmetry of the velocity probability angular distribution is destroyed, so the observation point cannot be taken on the z-axis generally. However, according to the axial symmetry, the observation point can still be taken on the xoz plane. The corresponding calculation is much more complicated, but we believe that under the action of the atomic nucleus at $\triangle t$ time interval, the electromagnetic fields generated by multiple collisions of STP still have similar mutual cancellation. Eventually, electrons cannot continuously radiate electromagnetic waves in any steady state of hydrogen atoms.

Starting from the random collision of STP under MIP, we demonstrated three important conclusions:

1. Free electrons do not radiate photons.

2. The electrons in the S state (the ground state is the S state with the lowest energy) in the hydrogen atom can not radiate photons continuously.

3. Only by combining electromagnetic theory and Brownian motion, the radiation problem of microscopic charged particles can be perfectly solved.

Based on these three conclusions, we have fundamentally solved the difficult problems that have never been truly solved from the Bohr model to the Copenhagen interpretation. Therefor, we have constructed a physical picture about the motions of charged particles in the microscopic world.

c) *Copenhagen interpretation revisited*

The Einstein-Bohr debate over quantum mechanics has never ended since a century ago. Einstein held the view of physical realism and strongly believed that a complete theory can not only explain and predict experimental results, but also describe the objective reality of the physical world. For this reason, Einstein proposed the EPR paradox to firmly oppose that the wave function of quantum mechanics is already a complete description of physical reality. Bohr and the Copenhagen school led by Bohr believed that before experimental measurement, the objective reality of the physical world could not be completely described by any theory. To give a famous example, the Copenhagen interpretation believes that before people detect electrons experimentally, we cannot even say that electrons exist objectively. The Einstein-Bohr debate had long remained at the level of philosophy or thought experiments until the discovering of sophisticated experimental results of Bell's inequality. The experimental results definitely violate Bell's inequality, which deny the possibility of any local hidden variable theories replacing quantum mechanics. These experiments seemed to be a great victory for Copenhagen interpretation, so criticisms of Copenhagen interpretation gradually became a forbidden area in modern physics, where all the loopholes of Copenhagen interpretation are covered up. The problem of charged particle radiation discussed in detail in this chapter is a typical example. Whether it is a free electron or an electron in a bound state, Copenhagen interpretation cannot directly answer a question: Why don't electrons continuously radiate electromagnetic waves if they are not moving in a straight line at a uniform speed? In our view, this is a very serious problem that must be focused on, because there is the big question of the objective reality of the microscopic world: How do electrons move before they are detected by experimental instruments? On the one hand, this motion must be consistent with all quantum mechanical experiments. On the other hand, it must not violate the predictions of electromagnetic theory. Only by solving this big problem, we can truly establish a materialist explanation of the microscopic world. According to MIP, we gave direct answers to following questions: 1. Before the electrons are detected by experimental instruments, the free electron performs frictionless Brownian motion. The electrons are not interfered by any human experimental behaviors, therefore Brownian motion is the underlying reality of the objective world. For the first time, we gave precise answers to questions that Copenhagen interpretation believed could not be asked or answered. Starting from this answer, a series of fundamental results such as Schrödinger's equation, Born's rule and Heisenberg's uncertainty principle can be naturally obtained. 2. Free electrons can not continuously radiate electromagnetic waves. The reason is that the high-frequency random collisions of STP cause the electromagnetic waves radiated by every instantaneous accelerated motion to cancel each other out. If there is no STP and no Brownian motion of electrons caused by STP, free electrons will inevitably radiate electromagnetic waves continuously which is a huge contradiction with the experimental results. 3. The electrons in the S state in the hydrogen atom will not continuously radiate electromagnetic waves, because the formation of spherically symmetric S state is precisely the result of the high-frequency random collision of STP. If there is no STP, electrons can only move in a plane under the action of centripetal force and there is no possibility for a spherically symmetric distribution. This spherically symmetric distribution combined with the characteristics of Brownian motion, ensures that the electromagnetic waves radiated by the instantaneous acceleration motion of the S-state electrons cancel each other out. 4. The analysis in this chapter logically leads to a major conclusion: electromagnetic theory is fully applicable in the microscopic world. The underlying motion of microscopic charged particles is purely classical and classical electrodynamics can be accurately described, provided that the Brownian motion is caused by the high-frequency collision of STP. There is no need to artificially postulate that the stationary state does not radiate like the Bohr model. The characteristics of Brownian motion will offset the electromagnetic radiation generated instantaneously. We must emphasize that classical physics cannot be assumed wrong in the microscopic world. Classical physics must be analyzed in depth from first principles. It is imprecise and wrong to conclude that classical electrodynamics is not applicable to microscopic particles based solely on the experimental stability of atoms, which obviously is not radiating electromagnetic waves. Within the framework of MIP, we proved that Maxwell's electromagnetic theory is fully applicable in the microscopic world. Free charged particles and S-state electrons of hydrogen atoms do not radiate electromagnetic waves. In summary, we have overcome the big problems that have existed since the beginning of Bohr's model, and brought a final end to the century-old debate between Einstein and Bohr. Einstein believed that the wave function cannot be a complete description of physical reality. This view is correct because the Brownian motion of material particles caused by STP is a complete description of physical reality. However, the idea that "God does not play dice" is wrong, by which Einstein meant that the behavior of the material world at its most fundamental level is not probabilistic. Because the underlying objective reality is that material particles are constantly performing Brownian motion. Every step of Brownian motion is probabilistic by its own nature . Only the existence of STP can present the probabilistic quantum mechanical behavior of microscopic particles and construct an objective and realistic picture of the microscopic world at the same time. This is the true essence of materialist interpretation of quantum mechanics proposed in this article.

XI. STP Vortices as an Origin of Fermion Spin

In this chapter, we will discuss the essence of spin from the topological structure of STP vortex.

While introducing into the gauge field in the 2+1 dimensional normal space, the singularity at the center of votex was resolved as a S^1. On the differential geometry point of view, this S^1 can be seen as the spatial edge of the vortex. Because of Hodge duality, we can obtain the dual S^1 which will be denoted as $S^{1\star}$. Hence in the 3+1 dimensional space-time, the simplest topological structure involving S^1 and $S^{1\star}$ is a Hopf link, which is a direct intersection of these two circles. As known in knots theory, there are more fundamental connect way for S^1 and $S^{1\star}$. The fundamental stone of topological intersection is the famous skein relation, which can be explicit as in the Fig.6

A single Hopf link actually have two twisted points, each of them is the mirror image of the other one. Mathematically, the two twisted points Hopf link is not the most fundamental topological structure. The most fundamental one is the single twisted point connection, which is shown in Fig.7

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Within the STP vortex configuration, we could have the following algebra-knot correspondence: the fundamental representation of the Lorentz group corresponds to the single twisted point connection of two cirles, which are edges of two dual vortices. The two twisted points connection corresponds to the adjoint representation of the Lorentz group.Under this framework, the algebraic representation of Lorentz group and the topological knot representation has a deep and explicit corelation.

Even in mathematics, this correspondence is a new conjecture, we do not have a direct proof at this stage. However, the indirect way to proof the conjecture is worth to study. For example, connect the affine representation to each other, that is saying, finding an integrable correlation between Schur polynomial and Jones polynomial.

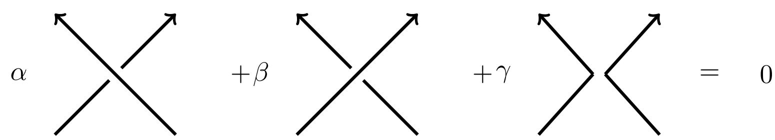


Figure 6: Skein relation

a) Topological phase transition of STP vortices

There are vortices on the tangent space and the normal space, since from the point view of isotropic STPs, there are no differences between these two spaces. Actually, in previous chapter, what we solved on the normal space has its Hodge dual on the tangent space. Therefore, in 3+1 dimensional space-time, we need to understand the interaction theory of two vortices living on dual spaces.

The interaction between two vortices can make centers of them fuse or intersect to each other. As we had known in previous chapter, because of the existence of gauge field, the singular center of the vortex had been resolved into a S^1. If there are no interactions between S^1 and its dual $S^{1\star}$, the dynamics on tangent space and normal space will completely decoupled. If this is the case, the dynamic of STPs around the matter particle will be un-isotropic and un-uniform. This obviously violates the physical fact. In other words, if the dynamics on tangent space and the one on normal space do not couple to each other, the space-time will be choked as slides. Hence the naturally way to couple these two dynamics of STPs leads to a phase transition.

The simplest topological phase transition is as shown in Fig.7. Notice that Edward Witten had used the skein relation developed by John Conway in 1969 to study knot invariant. It

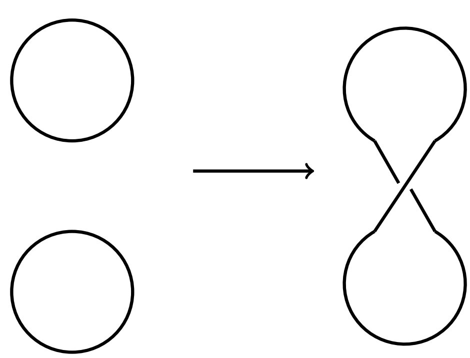


Figure 7: Topological phase transition of STP vortices

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

is amazing that the topological phase transition shown in7 is the same as John Conway's skein relation.

Therefore, we have already known the two vortices on tangent space and normal space respectively can form a topological twisted point through topological transition as well as the skein relation. For current double vortex case, because we could related the two vortices to each other by a single Lorentz rotation. This means the double vortex sysem has an internal symmetry. A careful study reveals the group is a double cover of $SO(3)$, respect to the Z_2 symmetry of the double vortices. this is because the center of STP vortex is what the matter particle sit on, hence in 3+1 dimensional spacetime, the two vortices have the same center. We splitted these two vortice by hand is a convenient way to explictly reprensent them. Therefore, the rotation subgroup of Lorentz group is the double cover of $SO(3)$, that is, $SU(2)$. This concludes the internal consistence between topological twisted point and spin.

b) The isotropic vortex

In previous chapter, we introduced into the 2+1 dimensional gauge field for vanishing the energy singularity at the center of STP vortex. The resolving of the singularity as an S^1 is the same as to introducing a $U(1)$ principal bundle structure in mathematics. The 2+1 dimensional gauge field is nothing but the connection on this principal bundle. However, the resolving operation blows up the singularity on the center of STP vortex does not reconfiguration all properties the singularity. As the center of STP vortex, the singularity is isotropic, but the circle S^1 is orientable. This means we covered the un-orientability of the singularity by the resolving operation. Now it is clear that we need to recover the un-orientability on the circleS^1.

In 1976, T. Martin [30] noticed that there is a correspondence in mathematics as follows. The rotation and translation effects can be separated geometrically. Hence there are two connections correspond to rotation and translation, respectively. The rotation connection corresponds to the torsion tensor, which has the similar meaning as curvature to translation effects.

We now consider the 2+1 dimensional STP vortex, it is nothing but a microscopic space-time. In this space-time, the torsion can not be negligible. The existence of microscopic torsion has no influence to the general relativity, since the geodesic line is unrelying on the torsion at all.

As saying in MIP, the matter particle obtains the mass property by collision of STPs and itself. In this picture, without STPs, the matter particle generated a space-time potential. The potential leads to a curved space-time around the matter particle. Microscopically, the metric around the matter is curved.

Before introducing the torsion tensor, we need to introduce the everywhere othogonal tangent vielbein field $e_a(x)$ as following

$$e_a(x) = e_a^i \frac{\partial}{\partial x^i}, \quad a = 0, 1, 2 \tag{10.1}$$

it satisfies the relation as:

$$g^{ij} = \eta^{ab} e_a^i e_b^j, \quad \eta_{ab} = g_{ij} e_a^j e_b^i \; . \tag{10.2}$$

It is natural to define the dual cotangent vielbein field, as:

$$\theta^a(x) = \theta^a_i dx^i \tag{10.3}$$

they satisfies the normal condition

$$< \theta^a, e_b >= \delta^a_b \tag{10.4}$$

and

$$g_{ij} = \eta_{ab}\theta^a_i\theta^b_j, \quad \eta^{ab} = g^{ij}\theta^a_i\theta^b_j \tag{10.5}$$

now the differential interval

$$ds^2 = g_{ij}dx^i dx^j = \eta_{ab}\theta^a_i\theta^b_j dx^i dx^j = \eta_{ab}\theta^a\theta^b \tag{10.6}$$

the spin connection can be defined by covariant differential on tangent vielbein field, as:

$$\omega^b_{ia}e_b = D_i e_a, \quad \omega^b_{ia} =< D_i e_a, \theta^b > \tag{10.7}$$

where $\omega^b_{ia}(x)$is the spin connection coefficient, and

$$\omega^b_a(x) = \omega^b_{ia}(x)dx^i \tag{10.8}$$

is the spin connection 1-form field. The covariant differential now is defined as following:

$$D' = \partial + \omega \tag{10.9}$$

when acting on a vector field $\xi^a(x)$,

$$D'_i\xi^a = \frac{\partial \xi^a}{\partial x^i} + \omega^a_{ib}\xi^b \tag{10.10}$$

Now we can discuss the coupling between spinor field and space-time under local Lorentz symmetry. If there is a spinor field (x), aka a spin representation of local Lorentz group, then on dynamical point of view, the momentum term of this spinor field can be written as:

$$D'_i\psi = \partial_i\psi + \frac{1}{2}\omega^{ab}_i\Sigma_{ab}\psi \tag{10.11}$$

here Σ_{ab} is the spin representation of Lorentz algebra,

$$[\Sigma_{ab}, \Sigma_{cd}] = \eta_{bc}\Sigma_{ad} + \eta_{ad}\Sigma_{bc} - \eta_{ac}\Sigma_{bd} - \eta_{bd}\Sigma_{ac} \tag{10.12}$$

Introducing the spin connection ω^{ab}_i, the parallel transition of cotangent field $\theta(x)$ defines the torsion of this manifold

$$\begin{aligned} \tau^a_{ik} &= D'_i\theta^a_k - D'_k\theta^a_i \\ &= \frac{\partial \theta^a_k}{\partial x^i} - \frac{\partial \theta^a_i}{\partial x^k} + \omega^a_{ib}\theta^b_k - \omega^a_{kb}\theta^b_i \end{aligned} \tag{10.13}$$

it is the field strength of the cotangent vielbein. When it is not zero, the manifold is not torsion-free and hence intrinsic twisted.The un-vanishing of the field strength of cotangent vielbein implies there is a multi-value property when we joint two 2+1 dimensional theories into a single 3+1 dimesnional theory. We know there exists a sigularity at the center of STP vortex, meanwhile the vielbein rounds the singularity, the vielbein will generate a monodromy matrix at the singularity. To incomplete the contribution of this 2×2 monodromy matrix, we need to consider the following action:

$$I = \int d^3x Tr[\epsilon^{ijk}\theta_i^a \tau_{jk}^a] + \int d^3x^\star Tr[\epsilon^{ijk}\theta_i^{a\star}\tau_{jk}^{a\star}] \tag{10.14}$$

here the Tr means summation on vielbein indices. The $\star$ indices means those torsion related variables are defined on dual 2+1 dimensional space-time. As we saw, (10.14) actually is a simple split joint of two 2+1 dimensional Chern-Simons theory defined on different boundary of the 3+1 dimensional space-time. Therefore, we need to introduce the joint constraint, which is obvious the Hodge duality. It is easy to proof that within the following constraint, the first term and the second term in (10.14) Hodge dual to each other. The constraint is :

$$\epsilon^{ijk}\theta_i^a = \epsilon^{ijkl}\tau_{il}^{a\star}, \quad \epsilon^{ijkl}\tau_{jk}^a = \epsilon^{ijl}\theta_j^{a\star} \tag{10.15}$$

Now the two 2+1dimensional Chern-Simons theory is fused into a 3+1 dimensional instanton interaction:

$$I = 2\int d^4x \epsilon^{ijkl} Tr\left(\tau_{il}^{a\star}\tau_{jk}^a\right) \tag{10.16}$$

We see, under the fused situation, the contribution of cotangent vielbein is completely equivalent to a topological instanton contribution of a gauge field. The instanton contribution is nothing but a constant, so now the task is to calculate this constant factor.

Written (10.16) as the differential form, it can be recognized as a characteric number in 3+1dimensional space-time. Notice when accomplish with the cotangent vielbein, on the 2+1 dimensional space-time, the boundary of the vortex could be seen as an S^2. We now joint two S^2 into a boundary of 3+1 dimensional space-time. If the concatenation is trivial, then the 3+1 dimensional spacetime has a boundary with topology $S^2 \times I$. However, the 3+1 dimensional space-time is $R^{3,1}$, when there exists no particles, the boundary is a null set. The boundary can be seen as an S^3 within the matter particle. So it means when we transform the two 2+1 dimensional vortices, the concatenation of their boundaries (S^2) is non-trivial. The final result of this concatenation is to generate an S^3. In fact, this is the way how the two 2+1 dimensional vortices become a microscopic stable configuration around the matter particle in 3+1 dimensional space-time.

Now consider the cobordism characteristic number of (10.16), it discribes the phase angle changing from $S^2 \times I$ to S^3. The phase angle difference describes the charactersitic number, we obtain:

$$I = 2 \times \frac{vol(S^3)}{vol(S^2)} \times N = 2 \times \frac{2\pi^2}{4\pi} \times N = \pi N \tag{10.17}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Here N is the topological number according to torsion τ, also known as the winding number. It describes the multiplicity of the mapping from $S^2 \times I$ to S^3 . In physics, it is the *theta* contribution.

When considering the wave function of matter particle, we do not see the contribution of the characteristic number. Therefore the topological phase transition just contributes the signature of the wave function, as:

$$\Psi^{[N]} = \psi(x,t)\exp(iI) = (-)^N \psi(x,t) \tag{10.18}$$

when the particle rotate around some fixed axe one whole circle, the corresponding 2+1 dimensional STP vortex also rotated one times around the S^3 , the result is the topological winding number changes by 1, now

$$\Psi^{[N]} \rightarrow \Psi^{[N+1]} \ or \ \Psi^{[N-1]} \tag{10.19}$$

as

$$\Psi \rightarrow -\Psi \tag{10.20}$$

so we have proved the spin of matter particle should be 1/2, as known as the Fermionic property.

From which we observed above, we obtain an important conclusion. The spin statistical property of matter particle is originate from the un-orintable of singularity sitting on the center of STP vortex around matter particle. This singularity is double covered, there are two 2+1 dimensional vortices around it. The two vortices reconstruct the singularity by manifold cobordism and thus incomplete the isotropic property of the singularity. The spin property of matter particle corresponds to the topological phase transition at the cobordism. In general, in the frame of MIP, the spin of matter particle describes the topological order that corresponding to topological phase transition of STP vortices around the matter particle.

c) *Pauli exclusion principle*

We now use s to label the topological order according to the topological phase transition of STP vortices. For union definition convenience, we let the topological order as a quantum evolution operator, that is:

$$e^{\frac{i}{\hbar}\hat{s}\theta}|\Psi\rangle = e^{i\theta/2}|\Psi\rangle \tag{10.21}$$

From this definition we could take this topological order as an operartor that has eigenvalue $\frac{\hbar}{2}$, for example, $\langle\hat{s}\rangle = \frac{\hbar}{2}$. The parameter of rotation one circle is $\theta = 2\pi$, subsitute this parameter into previous equation, one obtains the Fermionic statistical property immediately.

Now let us consider a permutation of two coincident particles. Suppose particle 1 is on the state $|\Psi_{x_1}(p)\rangle$ and particle 2 is on the state $|\Psi_{x_2}(p)\rangle$. Then the direct product system of these two particle is on the state $|\Psi_{x_1}(p)\rangle \otimes |\Psi_{x_2}(p)\rangle$. We could rotate the $|\Psi_{x_1}(p)\rangle$ as well as the$|\Psi_{x_2}(p)\rangle$ half a cirlce around the center between x_1, x_2 . Because the vortices around these two particles also rotated two half a circles, hence

$$T_{x_1,x_2}e^{i\pi\hat{s}}|\Psi_{x_1}(p)\rangle \otimes |\Psi_{x_2}(p)\rangle = e^{i\frac{\pi}{2}}|\Psi_{x_2}(p)\rangle \otimes e^{i\frac{\pi}{2}}|\Psi_{x_1}(p)\rangle$$

$$= -|\Psi_{x_2}(p)\rangle \otimes |\Psi_{x_1}(p)\rangle \tag{10.22}$$

here T_{x_1,x_2} exchanges x_1, x_2. Therefore if there are two coincident matter particles, on the same state, and sit on a same position, then it is easy to see a direct result from (10.22):

$$|\Psi_x(p)\rangle \otimes |\Psi_x(p)\rangle = -|\Psi_x(p)\rangle \otimes |\Psi_x(p)\rangle \tag{10.23}$$

when and only when $|\Psi_x(p)\rangle \otimes |\Psi_x(p)\rangle = 0$ the previous result can be the case. however, $|\Psi_x(p)\rangle \otimes |\Psi_x(p)\rangle = 0$ means the state actually does not exist! So the Pauli exclusive principle is a natural result in the frame of MIP.

d) STP as shepherd of matter particles

MIP explains all the essences of quantum mechanics both qualitatively and quantitatively without relying on any special hypothesis, which sweeps away the last traces of idealism in quantum mechanics from the Copenhagen interpretation. Fundamentally, MIP requires a massless and spinless scalar particle, i.e. STP. The existence of STP is an objective fact in physics, which is different from the wave function of quantum mechanics. Therefore, this paper can thoroughly solve a series of extremely important problems that cannot be answered by quantum mechanics alone:

How can a matter particle be sure that its momentum and position satisfy a certain uncertainty relationship? Why can a matter particle exhibit wave-particle duality? How does a matter particle know energy levels where it can go and where it absolutely cannot go, that is , how can they satisfy the Pauli exclusion principle? Quantum mechanics only reles on a series of postulations to avoid the above problems. MIP not only solves the above problems by mathematical derivations, but also allows matter praticles behave exactly as required by quantum mechanical postulations.

At the level of objective reality, all the microscopic behaviors of matter particles are rooted in their commen shepherd– STP. The random collision of STP, which seems to be chaotic, is actually the supervisor of all microscopic behaviors of matter particles. The wonderful quantum world was born because of these ubiquitous supervisors.

Quantum mechanics, as one of the most successful physical sciences, ultimately cannot avoid the problem of its completeness. In an era where the fundamental question of how matter particles obey the postulations of quantum mechanics cannot be answered, the completness of quantums mechanics cannot be treated properly. When the theory of STP and MIP are discovered, in which STP is the supervisor and shepherd of all quantum behavious of matter particles, the question of quantum mechanical completeness are ready for profound investigations. MIP and its STP have taken a big step forward to finally slove the long lasting puzzle of quantum mechanical completeness.

XII. Muon Physics and MIP

a) Theoretical framework

Under the framework of MIP, STPs collide with material particles. In quantum field theory, this is equivalent to introduce a massless scalar field into the theory and its interaction with material particles. Therefore, the Standard Model of particle physics needs to be revised as:

$$\mathcal{L} = \mathcal{L}_{SM} + \mathcal{L}_{ST} + \mathcal{L}_{int} \tag{11.1}$$

In the above formula, $\mathcal{L}_{SM}$ is the Lagrangian of the standard model of particle physics; $\mathcal{L}_{ST}$ is the kinetic energy term of the STPs scalar field, which can be expressed as for:

$$\mathcal{L}_{ST} = \frac{1}{2}\partial_\mu \phi \partial^\mu \phi \tag{11.2}$$

Since the strength of the collision between STPs and material particles is proportional to the mass of the particles, the interaction term between STPs and material particles is expressed as:

$$\mathcal{L}_{int} = \lambda \sum_{i \in \text{all matter fields}} m_i \phi \bar{\Psi}_i \Psi_i \ . \tag{11.3}$$

Where $_i$ represents the material particles in the Standard Model, that is, leptons and quarks. m_i is the mass of the corresponding material particles.

Obviously, for material particles, the mass itself already reflects the information of the collision and interaction between STPs and material particles. So at the tree level, the interaction (11.3) does not change any physics. But at the order of loop diagrams, the interaction of the above equation is ignored by the Standard Model of particle physics.

In this chapter, we will consider the modification of muon physics caused by the interaction of STPs with muons, which includes two aspects. One is the correction of muon anomalous magnetic moment. The second is the lifetime of muon. Muon physics is considered because muons are two hundred times more massive relative to electrons. This means that at the loop diagrams, STPs are about 10^4 times larger than electrons for the correction of muon physics. On the other hand, electrons do not decay, and the effect of STPs cannot be verified in experiments.

b) muon anomalous magnetic moment

The anomalous magnetic moment of the muon is contributed by a triangular Feynman diagram. The single loop contribution of the STPs scalar field to the muon anomalous magnetic moment can be represented by a Feynman diagram 8. As early as 1972, Jackiw and Weinberg have calculated the contribution of this graph [31], and its contribution to the muon anomalous magnetic moment is:

$$\Delta g_\mu = \frac{3\lambda^2 m_\mu^2}{8\pi^2} \ . \tag{11.4}$$

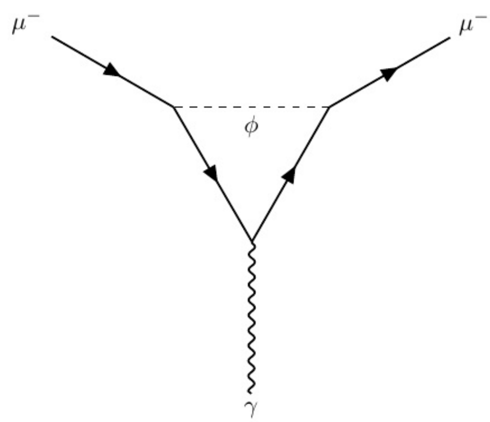


Figure 8: Feynman diagram of the contribution of STPs to the anomalous magnetic moment of muon

Jackiw and Weinberg call this contribution in their paper the "virtual scalar field" contribution. Since this "virtual scalar field" does not exist in the Standard Model, the contribution of this scalar field is not considered in subsequent experimental verifications. But in MIP, this scalar field exists undoubtedly , and it refers to the scalar field of STPs. Therefore we need to consider its contribution to the anomalous magnetic moment of muon.

As early as 2006, Brookhaven National Laboratory in the United States discovered experimentally that there is a 3.3σ difference between the anomalous magnetic moment of muon and the prediction of the Standard Model[32], that is,

$$a_\mu(\mathrm{BNL}) = 116592080(63) \times 10^{-11}(0.54\mathrm{ppm}).$$

Where $a_\mu = \frac{g_\mu - 2}{2}$ is the difference value of muon anomalous magnetic moment. In 2021, the Fermi National Laboratory in the United States accurately measured the difference value of the muon anomalous magnetic moment[33], and the result was:

$$a_\mu(\mathrm{FNAL}) = 116592040(54) \times 10^{-11}(0.46\mathrm{ppm}).$$

Combining two experiments, the average of anomalous magnetic moment is:

$$a_\mu(\mathrm{EXP}) = 116592061(59) \times 10^{-11}(0.35\mathrm{ppm}).$$

From the standard model, the theoretical value of a_μ is:

$$a_\mu(\mathrm{SM}) = 116591810(43) \times 10^{-11}(0.37\mathrm{ppm}).$$

The deviation between experiment and theory is:

$$a_\mu(\mathrm{EXP}) - a_\mu(\mathrm{SM}) = 251 \pm 59 \times 10^{-11}.$$

This deviation reaches 4.2σ, so it is a very significant deviation. This means there is a high probability that the contribution of a certain particle is missing from the Standard

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Model. Under the MIP framework, we believe that this deviation comes entirely from the contribution of STPs. From this deviation, the coupling constant λ of STPs and material particles can be determined, Its value is given as follows:

$$\lambda^2 = (a_\mu(\mathrm{EXP}) - a_\mu(\mathrm{SM}))\,\frac{16\pi^2}{3m_\mu^2}$$

$$= 1.18349(\pm 0.27819) \times 10^{-11}\mathrm{MeV}^{-2} \tag{11.5}$$

$$\lambda = 3.44019^{+0.38300}_{-0.43137} \times 10^{-6}\mathrm{Mev}^{-1} \tag{11.6}$$

Therefore, the introduction of the interaction between STPs and muon can completely match the theoretical and experimental results of muon anomalous magnetic moment.

c) *Muon decay problem*

Furthermore, to demonstrate the self-consistency of the scalar field introduced into STPs, we also need to consider the corresponding physics of the single loop interactions between STPs and material particles. In other words, if the introduction of the STPs scalar field and its coupling strength λ results in a contradiction between the theory of a certain physical process and the corresponding experimental results, it is proved that the STPs scalar field is not the source of the deviation of the muon anomalous magnetic moment. Therefore, we consider the single loop process in the muon decay problem. With the participation of STPs, the corresponding Feynman diagram is shown in Figure 9:

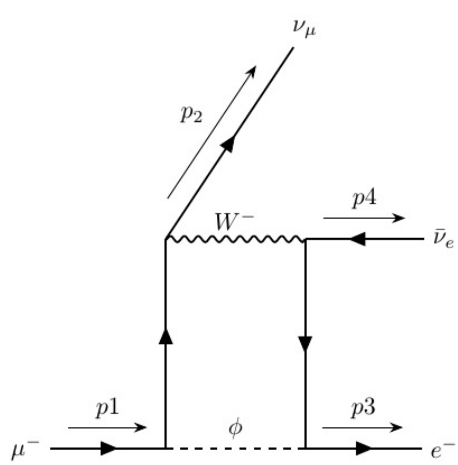


Figure 9: Feynman diagram of the single loop contribution of STPs to the muon decay

The scattering amplitude $\mathcal{M}$ of this box Feynman diagram is:

$$i\mathcal{M} = -\frac{g_w^2\lambda^2 m_\mu m_e}{8}\int \frac{d^4k}{(2\pi)^4}\frac{\mathcal{D}(k,p,m)}{\mathcal{N}(k,p,m)} \tag{11.7}$$

$$\begin{aligned}\mathcal{D}(k,p,m) &= \bar{v}(p_2)\gamma^\mu(1+\gamma^5)(\not{k}+m_\mu)u(p_1)\times \\ &\quad \bar{u}(p_3)(\not{k}-\not{p}_3-\not{p}_4+m_e)\gamma_\mu(1-\gamma^5)v(p_4)\end{aligned} \tag{11.8}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

$$\begin{aligned}\mathcal{N}(k,p,m) &= \left[(k^2 - m_\mu^2 + i\epsilon)\right]\left[((k-p_2)^2 - m_W^2 + i\epsilon)\right] \times \\ &\quad \left[(k-p_3-p_4)^2 - m_e^2 + i\epsilon\right]\left[(k-p_1)^2 + i\epsilon\right] \end{aligned} \tag{11.9}$$

Without introduction of the STP scalar field, the scattering amplitude of the muon decay can be labeled as follows:

$$\mathcal{M}_{ST} = \mathcal{M}_{tree} + \mathcal{M}_{1-loop} + \mathcal{M}_{2-loop} + \cdots$$

After introducing the STP scalar field, the absolute square of the scattering amplitude can be written as:

$$\begin{aligned}|\mathcal{M}|^2 &= (\mathcal{M}_{ST} + \mathcal{M})(\mathcal{M}_{ST}^* + \mathcal{M}^*) \\ &= |\mathcal{M}_{ST}|^2 + 2\mathrm{Re}\left[\sum_{\text{all spins}} \mathcal{M}_{tree}^* \mathcal{M}\right] + \text{higher order terms}\end{aligned} \tag{11.10}$$

therefore, we only need to calculate $\mathrm{Re}\left[\sum_{\text{all spins}} \mathcal{M}_{tree}^* \mathcal{M}\right]$ to get the correction of the scattering amplitude.

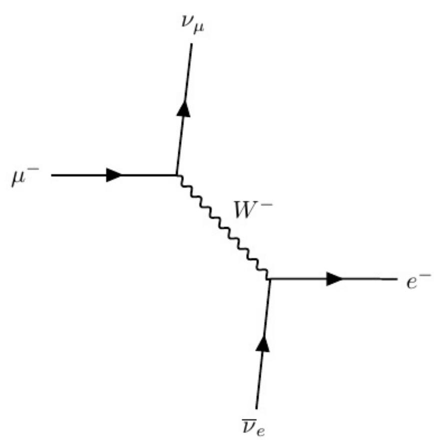


Figure 10: Muon decay tree diagram

$\mathcal{M}_{tree}$ represents the contribution of figure 10, and its expression is as follows:

$$\mathcal{M}^*{}_{tree} = -\frac{g_w^2}{8m_W^2 c^2}\bar{u}(p_1)\gamma^\mu\left(1-\gamma^5\right)u(p_2)\bar{v}(p_4)\left(1+\gamma^5\right)\gamma_\mu u(p_3) \tag{11.11}$$

Condensing all Dirac matrices and using Casimir's trick, we finally get:

$$\sum_{\text{all spins}} \mathcal{M}_{tree}^* \mathcal{M} = i\frac{4g_w^4\lambda^2 m_\mu m_e}{m_W^2 c^2}\int \frac{d^4k}{(2\pi)^4}\frac{[(k+p_1)\cdot p_4][(k+p_1-2p_4)\cdot p_2]}{\mathcal{N}(k,p,m)} \tag{11.12}$$

We compute this integral using the Mellin–Barnes (MB) representation [34, 35, 36, 37, 38] developed by V. A. Smirnov et al. (See Appendix F)For the integral kernel in (11.12), we can do the substitution $k + p_1 \to k$, and then use the Mellin–Barnes representation to express it as factor multiple form of the Γ function(See Appendix F), and finally the MB integral is used to do the appropriate contour integration. Since there are multiple Γ function poles that overlap, the order of the contour integration needs to be evaluated at multiple singular points. We denote the result of the integration of k as $\mathcal{F}(s,t,m)$, where $s = (p_1 - p_2)^2, t = (p_1 - p_3)^2$ is the Mandelstam variable. In muon's stationary reference frame, where $p_1 = (m_\mu c^2, 0, 0, 0)$, the decay rate of muon is

$$\mathrm{d}\Gamma = \frac{\langle|\mathcal{M}|^2\rangle}{2\hbar m_\mu}\left(\frac{\mathrm{d}^3\mathbf{p}_2}{(2\pi)^3 2|\mathbf{p}_2|}\right)\left(\frac{\mathrm{d}^3\mathbf{p}_3}{(2\pi)^3 2|\mathbf{p}_3|}\right)\left(\frac{\mathrm{d}^3\mathbf{p}_4}{(2\pi)^3 2|\mathbf{p}_4|}\right)$$

$$\times (2\pi)^4\delta^4(p_1 - p_2 - p_3 - p_4) \tag{11.13}$$

The momentum of the electron, anti-electron neutrino and muon neutrino are also clearly written down, which are:

$$p_2 = (|\mathbf{p}_2|c, \mathbf{p}_2),\ p_3 = (\sqrt{|\mathbf{p}_3|^2c^2 + m_e^2c^4}, \mathbf{p}_3),\ p_4 = (|\mathbf{p}_4|c, \mathbf{p}_4) \tag{11.14}$$

Substituting the above formula and the momentum of muon p_1 into $\mathcal{F}(s,t,m)$, it becomes $\mathcal{F}(|\mathbf{p}_2|, |\mathbf{p}_3|, m_e, m_\mu, m_W)$ Then the change of decay rate caused by STP is:

$$\Delta\Gamma_{ST} = -\frac{g_w^4\lambda^2 m_e}{8\pi^3 m_W^2 c^2\hbar}\int_0^{m_\mu c/2}\mathrm{d}|\mathbf{p}_2|\int_{m_\mu c/2-|\mathbf{p}_2|}^{m_\mu c/2}\mathrm{d}|\mathbf{p}_3|\mathrm{Im}\left(\mathcal{F}(|\mathbf{p}_2|, |\mathbf{p}_3|, m_e, m_\mu, m_W)\right) \tag{11.15}$$

Substituting into the numerical calculation shows that:

$$\Delta\Gamma_{ST} = 1.2141 \pm (0.2854)s^{-1} \tag{11.16}$$

The muon decay rate calculated from the Standard Model is:

$$\Gamma_{SM} = 455169.311 s^{-1} \tag{11.17}$$

Therefore, the lifetime of muon under the action of STP is:

$$\tau_\mu = 1/(\Gamma_{SM} + \Delta\Gamma_{ST}) = 21969788(\pm 14) \times 10^{-13}s \tag{11.18}$$

Experimentally, the muon lifetime is

$$\tau_\mu(\mathrm{Exp}) = 21969811(\pm 22) \times 10^{-13}s \tag{11.19}$$

It can be seen that after adding the contribution of the STP scalar field, the theoretical lifetime of the muon perfectly matches the experimental observations.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Just as we finished the writting work on this article, we noticed the breaking news about the mass of W boson. In this article [44], the mass of W boson is given as:

$$m_W = 80433.5(\pm 9.4)\ MeV/c^2\ . \tag{11.20}$$

Using this new W boson mass, we recalculated the STP scalar field contribution, and it shows:

$$\Delta\Gamma_{ST}^{new} = 0.9273 \pm (0.2180)s^{-1}, \tag{11.21}$$

hence the new lifetime of muon under the action of STP is:

$$\tau_\mu^{new} = 1/(\Gamma_{SM} + \Delta\Gamma_{ST}^{new}) = 21969802(\pm 10.5) \times 10^{-13}s\ . \tag{11.22}$$

This result is even better fitting the experiment result than the privious one, which provides strong support on our propose of STP. We also noticed the breaking news about the mass of W boson [44], which says that there is a significiant deviation between the standard model prediction and experiment. Using this new boson mass, we recalculated the STP scalar field contribution, which shous the result obtained in (11.12) is not sensitive to the new W boson mass. This is because in this article the Feynman diagrams we calculated for interaction between STP and W boson is not sensitive to the mass of W boson.

d) Lepton anomalous magnetic moment and MIP

We have considered the effects of MIP in muon physics. Introducing the STP scalar field, the anomalous magnetic moment of the muon and the decay lifetime can be well explained. Correspondingly, we can consider the deviations of other leptons after the introduction of STP.

i. *Electron anomalous magnetic moment*

The measurement of the electronic anomalous magnetic moment has been very accurate. The current experimentally determined electron anomalous magnetic moment is[39]:

$$a_e(\text{Exp}) = (1159652180.91 \pm 0.26) \times 10^{-12} \tag{11.23}$$

On the other side, in framework of standard model, the calculation of the anomalous magnetic moment of electron, strongly depends on the accurate value of fine structure constant α , which determined by experiment. At the level of 10^{-12}, the deviation of α is relative big. Therefore the theoretical calculation for anomalous magnetic moment of electron spands on a relative big range[40, 41, 42]. The results obtained by the theoretical calculation of the standard model are:

$$a_e^{\text{SM}}(\text{Rb}) = (1159652180.252 \pm 0.095) \times 10^{-12} \tag{11.24}$$

$$a_e^{\text{SM}}(\text{Cs}) = (1159652181.61 \pm 0.23) \times 10^{-12} \tag{11.25}$$

The differences between the theoretical calculation and experimental value are:

$$\Delta a_e(\text{Rb}) = a_e^{\text{SM}}(\text{Rb}) - a_e(\text{Exp}) = -(0.658 \pm 0.355) \times 10^{-12} \tag{11.26}$$

$$\Delta a_e(\text{Cs}) = a_e^{\text{SM}}(\text{Cs}) - a_e(\text{Exp}) = +(0.7 \pm 0.49) \times 10^{-12} \tag{11.27}$$

After introducing STP, the correction value of the electronic magnetic moment is:

$$\begin{aligned}\Delta a_e^{\text{MIP}} &= \frac{3\lambda^2 m_e^2}{16\pi^2} = \frac{3 \times (1.18349 \pm 0.27819) \times (0.51099895)^2 \times 10^{-11}}{16 \times 3.1415926536^2} \\ &= (0.0587 \pm 0.0138) \times 10^{-12}\end{aligned} \tag{11.28}$$

According to above calculation, we know the correction due to STP scalar field is one level smaller than current theory-experment gap. However, the gap is mainly caused by the accuracy of fine structure constant, which is an experimental error. Therefore, under the current experiments, the electronic anomalous magnetic moment does not have a bigger deviation due to the existence of STP. The deviation due to STP field, is consistent with current experiments on the anomalous magnetic moment of electron.

ii. *Tauon anomalous magnetic moment*

Due to the relatively short lifetime of tauon, it is difficult to accurately measure its anomalous magnetic moment in such a short time. The relative experiment only can give a very rough region as follows [43]:

$$-0.052 < a_\tau(\text{Exp}) < 0.013 \tag{11.29}$$

with confidential level 95%.

The tauon anomalous magnetic moment calculated by the current standard model is[43]:

$$a_\tau(\text{SM}) = (117721 \pm 5) \times 10^{-8} \tag{11.30}$$

After the introduction of STP, the corrected value of tauon magnetic moment is:

$$\begin{aligned}\Delta a_\tau^{\text{MIP}} &= \frac{3\lambda^2 m_\tau^2}{16\pi^2} = \frac{3 \times (1.18349 \pm 0.27819) \times (1776.86)^2 \times 10^{-11}}{16 \times 3.1415926536^2} \\ &= (7.0986 \pm 1.6686) \times 10^{-7}\end{aligned} \tag{11.31}$$

The ratio of this corrected value to the theoretical value is

$$\rho_\tau = \frac{\Delta a_\tau^{\text{MIP}}}{a_\tau(\text{SM})} \simeq 0.0006 \tag{11.32}$$

In fact, this correction ratio is the largest among the three generations of leptons. However, the experiment on tauon anomalous magnetic moment is quite difficult, the experiment uncertainty is huge comparing to the deviation due to STP field. Though we can predict the STP scalar field would bring in a small correction, the current tauon experiments are far away to the correction. However, the deviation due to STP field, is consistent with current experiments on the anomalous magnetic moment of tauon.

e) Summary

In this chapter, we consider two modifications for muon physics due to STP. First, we consider the correction of the STP scalar field to the muon anomalous magnetic moment. The interaction strength λ between the STP scalar field and the matter particle is determined. Second, we calculate the correction of the STP scalar field for muon decay, which makes the theoretical predictions agree with the experimental observations perfectly. It can be seen that we only need to introduce one free parameter, the STP scalar field interaction strength, we achieved a great triumph in the area of muon physics.

XIII. Entropy in MIP

Phase space is a delicate concept. Within the framework of MIP, the coordinates and momentum of particles can be completely independent, so the phase space has real physical meaning. Discussing the issue of entropy for non-interacting particle in the phase space will be more clear and insightful.

a) Entropy in phase space

Let us first consider a matter particle of mass m in a harmonic oscillator potential. The energy of a particle is the sum of its kinetic energy and potential energy

$$E = \frac{p^2}{2m} + \frac{1}{2}kx^2 \tag{12.1}$$

Where k is the stiffness coefficient of the spring. According to Newton's second law

$$m\ddot{x} = F = -\frac{dV}{dx} = -kx \tag{12.2}$$

and

$$k = m\omega^2 \tag{12.3}$$

Where ω is the frequency of particle vibration.

The state of a particle is characterized by (x, p). In the (x, p) space, each point represents a state of the particle. This space is named phase space, and the motion of the particles constitutes the trajectory in the phase space.

For each fixed energy E, the particle's trajectory in phase space is an ellipse. According to the definition of ellipse, we can write

$$\frac{p^2}{2mE} + \frac{x^2}{\frac{2E}{m\omega^2}} = 1 \tag{12.4}$$

We can determine the two axis lengths of the ellipse

$$a = \sqrt{2mE} \tag{12.5}$$

$$b = \sqrt{\frac{2E}{m\omega^2}} \tag{12.6}$$

According to MIP, a particle moves along an ellipse in phase space for a period, and it must exchange with the STP an integer multiple of the Planck constant

$$\oint pdx = nh \tag{12.7}$$

It can be seen from the geometric meaning of the integral that the integer value corresponds exactly to the area of the ellipse

$$\oint pdx = \pi ab = \frac{2\pi E}{\omega} \tag{12.8}$$

From this we get important results

$$E = n\hbar\omega \tag{12.9}$$

This proves that every possible state occupies the same area in the phase space. This is the most important difference between quantum mechanics and classical mechanics: The energy levels are discrete, which means not all energy levels are allowed for real motions. In the phase space, only discrete ellipses are possible movements, corresponding to possible states.

With this important result, we can start to count the number of possible states to determine the entropy. Intuitively, for the elliptic family of phase space, the volume of the phase space occupied by each possible E (for the sake of intuition, we are talking about one-dimensional motion, the corresponding phase space is 2 dimensions, and therefore the area), which is exactly The area A surrounded by two adjacent ellipses. The most important thing is that this area A is a constant. Similarly we can calculate this constant as

$$A = \oint_{E=(n+1)\hbar\omega} pdx - \oint_{E=n\hbar\omega} pdx = h \tag{12.10}$$

If we further consider the net effect $1 + 1 + 1 + ... = \zeta(0) = -\frac{1}{2}$ of the infinite collisions of STP, we can get the complete result of quantum mechanics: The energy level of a simple harmonic oscillator is $E = (n + \frac{1}{2})\hbar\omega$.

b) Entropy at absolute zero

Let us first consider the entropy at absolute zero, and then discuss the entropy of thermodynamics. The entropy at absolute zero must be equal to zero, according to the definition of Boltzmann entropy, which means the entropy is the logarithm of all possible microscopic

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

states at the same energy. It is equivalent to say that there can be only one state at absolute zero, so its entropy is 0.

If we look at the typical time scale of quantum mechanics, this conclusion is correct. Due to STP colliding at the short time scale of MIP, the wave function formed on the quantum mechanical time scale is a pure state, and its entropy must be zero.

Free particles in quantum mechanics can be characterized by plane waves $e^{i\vec{p}\cdot\vec{x}/\hbar}$, where $\vec{p}\cdot\vec{x}/\hbar$ is called the phase factor of the wave function. In the time scale of MIP, we will generalize this key factor.

First, in this extremely short time scale, according to Section 3.5, we generalized the momentum of quantum mechanics $\vec{p}$ to instantaneous momentum $\vec{P}_i$. Second, the instantaneous momentum is not a conserved quantity. The original phase factor $\vec{p}\cdot\vec{x}$ must be generalized to $\int_\gamma \vec{P}_i \cdot d\vec{x}$. Third, for non-interacting particles, aka free particles, we can always choose an inertial frame of reference with zero classic statistical velocity. Furthermore, the integral of the random velocity through the path γ on the time scale of quantum mechanics is 0. Therefore, the contribution only comes from envelope velocity.

The number of all possible microscopic states of a particle can be characterized by its envelope velocity u. Within a short time scale, different envelope velocity can represent different possible states. We can construct entropy Within the framework of MIP, and then find the following way to pass to the long-term scale, the result of quantum mechanics about entropy.

Based on the above three points about particles traveling a path γ at the time scale of quantum mechanics, we can generalize the phase factor in quantum mechanics to

$$K_i = \frac{1}{\hbar}\int_\gamma \vec{P}_i \cdot d\vec{x} = \frac{m_{st}}{h}\int_\gamma \vec{u_i}\cdot d\vec{x} \tag{12.11}$$

All the possible state under the time scale of MIP are represented by different i and K_i is a dimensionless quantity. From the conclusion of Chapter 5, the envelope velocity is an irrotational field

$$\nabla \times \vec{u} = 0 \tag{12.12}$$

So K_i does not depend on the path γ, which is just a function of the endpoint. It must be noted that entropy is a variable of state, regardless of how to reach the state.
The probability of possible state i is defined as

$$p_i = \frac{1}{N} e^{2K_i} \tag{12.13}$$

Where the normalization constant

$$N = \sum_i e^{2K_i} \tag{12.14}$$

In order to guarantee that the probability sum of various possible states equals to 1, we have

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

$$\sum_i p_i = 1 \tag{12.15}$$

and the probability of all possible states are greater than 0.

Within the framework of MIP and the probability of possible states on a short time scale, we can define the corresponding entropy as

$$S = -\sum_i p_i \log p_i \tag{12.16}$$

By this definition, we claim that all results of quantum mechanical entropy can be derived.

The derivation is as follows:

Obtaining the gradient on both sides of Equation 11:

$$\nabla K_i = \frac{m_{st}}{h}\vec{u_i} \tag{12.17}$$

For each possible state i, the wave function ψ_i will emerge on the quantum mechanical time scale as

$$|\psi_i| = \frac{1}{\sqrt{N}} e^{K_i} \tag{12.18}$$

In every possible state, K_i corresponds exactly to the original potential function R. Thus our definition of entropy is equivalent to

$$S = -\sum_i 2|\psi_i|^2 \log|\psi_i| \tag{12.19}$$

This is completely equivalent to the definition of von Neumann entropy in quantum mechanics. We choose the envelope velocity to define the probability of microscopic states, so that the corresponding probability will match the probability from Born's interpretation exactly, which is the absolute square of wave functions. In this way, we guarantee that our definition of entropy can go back to the quantum mechanical definition of entropy. The principle of entropy increasing proved by MIP is the same principle in statistical physics. Therefore, from the microscopic behavior of the envelope velocity in the short time scale of MIP, quantum mechanical entropy in the long time scale is derived.

We can summarize this section: at absolute zero and within the time scale of MIP, the entropy of matter particles is not zero, and its various microscopic states are characterized by different envelope velocities. According to the conclusions in Chapter 5, reaching the time scale of quantum mechanics after a long time of random collision, the material particles at absolute zero appear as a pure state wave function, and its evolution satisfies the Schrödinger equation. Then the probability of only one state i is 1, and the probability of other states is 0, which naturally leads to the conclusion of quantum mechanics: the entropy is 0 at absolute zero .

c) Entropy at finite temperature

When we consider not only the quantum behavior of single particle but also the thermodynamic properties of multiple particles without interactions, the work in the previous section needs to be further generalized. In the first step, we generalize to the case of two particles. The probability that one is in state i and the other is in state j is $p_i\tilde{p}_j$. If they are identical particles, two probability distribution functions are the same. According to the definition of entropy, the entropy of two particle systems is

$$\begin{aligned} S &= -\sum_{ij}(p_i\tilde{p}_j)\log(p_i\tilde{p}_j) = -\sum_{ij} p_i\tilde{p}_j \log p_i - \sum_{ij} p_i\tilde{p}_j \log \tilde{p}_j \\ &= -\sum_i p_i \log p_i \sum_j \tilde{p}_j - \sum_j \tilde{p}_j \log \tilde{p}_j \sum_i p_i \\ &= -\sum_i p_i \log p_i - \sum_j \tilde{p}_j \log \tilde{p}_j \\ &= S_1 + S_2 \end{aligned} \tag{12.20}$$

Additivity is obtained, which is the fundamental property of entropy. This can be directly extended to the entropy of any multi-particle system, which is equal to the sum of the entropy of each single particle. That is to say, the macroscopic thermodynamic entropy is the sum of the entropy of each part of the subsystem. And we treat each single particle as an independent subsystem, which is the smallest subsystem possibly. To be connected with thermodynamic entropy, we need to introduce temperature.

The second step is to define the temperature in the MIP framework as following. We have proved the additivity of entropy from MIP. Use this basic property to define the physical quantity of temperature. Assuming that the energy of two subsystems is E_1 and E_2, the total energy of the system $E = E_1 + E_2$ is a conserved quantity. By the additivity of entropy, we have

$$S(E) = S_1(E_1) + S_2(E_2) \tag{12.21}$$

The total system is a closed system. When in equilibrium, the derivative of both sides with respect to E_1 leads to

$$0 = \frac{dS_1}{dE_1} + \frac{dS_2}{dE_2}\frac{dE_2}{dE_1} = \frac{dS_1}{dE_1} - \frac{dS_2}{dE_2} \tag{12.22}$$

It can be seen that there is a physical quantity in equilibrium, which is possessed by all subsystems equally. We call this physical quantity the temperature T, which is defined as

$$\frac{dS}{dE} = \frac{1}{T} \tag{12.23}$$

That is

$$\frac{dS_1}{dE_1} = \frac{1}{T_1} = \frac{dS_2}{dE_2} = \frac{1}{T_2} \tag{12.24}$$

In the third step, we introduce temperature into the definition of entropy, in order to study the entropy of thermodynamics under the framework of MIP. Let us consider the microscopic collision process under the MIP framework. When a material particle collides with an STP, the material particle is in state a and the STP is in state b. After the collision, the state of the material particle changes to c, and the STP state changes to d. The probability of this process is proportional to $n_a n_b$, that is, in the initial state, there are n_a material particles in state a, and n_b material particles are in state b. Then we consider a reverse process whose probability is proportional to $n_c n_d$. According to MIP, the STP collision process has time-reversal symmetry and the material particles must reach an equilibrium state with the STP, that is, the average number of particles in each state does not change. Then we have

$$n_a n_b = n_c n_d \tag{12.25}$$

Conservation of energy of the collision process leads to

$$\epsilon_a + \epsilon_b = \epsilon_c + \epsilon_d \tag{12.26}$$

It can be proved that

$$n_i = Ce^{-\beta\epsilon_i} \tag{12.27}$$

Among them, the constant C is given by

$$\sum_i n_i = N \tag{12.28}$$

According to the basic definition of probability theory, the probability of being in the i state is

$$p_i = \frac{n_i}{N} = \frac{1}{\sum_i e^{-\beta\epsilon_i}} e^{-\beta\epsilon_i} \tag{12.29}$$

This p_i is the generalization of the probability distribution at a finite temperature. According to the definition of temperature, it can be proved that the coefficient β must be equal to $\frac{1}{T}$. From this we get the entropy at finite temperature

$$S = -\sum_i p_i \log p_i \tag{12.30}$$

We can directly substitute the specific expression of the probability distribution p_i to get the thermodynamic entropy as

$$S = -\sum_i \frac{1}{\sum_i e^{-\beta\epsilon_i}} e^{-\beta\epsilon_i} \log \frac{1}{\sum_i e^{-\beta\epsilon_i}} e^{-\beta\epsilon_i} = \frac{E-F}{T} \tag{12.31}$$

In this way, the general expression of thermodynamics is obtained, where the free energy of thermodynamics reads

$$F = -T \log \sum_i e^{-\epsilon_i/T} \tag{12.32}$$

And internal energy as

$$E = \frac{1}{\sum_i e^{-\epsilon_i/T}} \sum_i \epsilon_i e^{-\epsilon_i/T} \tag{12.33}$$

Within the framework of MIP, the energy of non-relativistic free material particles is expressed in terms of true velocity

$$\epsilon = \frac{1}{2} m V^2 \tag{12.34}$$

Substituting the distribution function of the true velocity of the material particles at a finite temperature

$$\Phi(V^2) = (\frac{m}{2\pi T})^{3/2} e^{-\frac{mV^2}{2T}} \tag{12.35}$$

Then we can further give the definition of classical statistical velocity in the decomposition of three velocities

$$v = \int V \Phi(V^2) d^3V = \sqrt{\frac{8T}{m\pi}} \tag{12.36}$$

which shows a deeper understanding of the physical meaning of the decomposition of three velocities. The entropy at absolute zero corresponds to the quantum envelope velocity of material particles, while the entropy at finite temperature includes the contributions from all three velocities. From finite temperature to absolute zero, the physical quantity describing the system has undergone a fundamental change. Therefore, thermodynamics cannot determine the value of entropy at absolute zero, which can be obtained naturally under the MIP framework.

d) Comparing between entropy at finite temperature and absolute zero

In modern information theory, entropy (Shannon entropy) is a measure of uncertainty. This basic concept is consistent with MIP. The study of the diffusion coefficient of material particles at finite temperature shows that, the uncertainty of the thermodynamic contribution of finite temperature is much smaller than the quantum contribution at absolute zero in MIP.

MIP shows that matter particles do Brownian motion under random collisions of STP, the most important property of this motion is

$$< X^2 >= 2\Re t \tag{12.37}$$

Where $\Re$ is the space-time diffusion coefficient $\Re = \frac{\hbar}{2m}$. Obviously, this is a result at absolute zero, has nothing to do with temperature, purely caused by Planck's constant.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

In the framework of classical physics, the Planck constant is 0, so there is no such diffusion coefficient, and of course there is no such Brownian motion. However, there will still be Brownian motion caused by thermal motion. So the space-time diffusion coefficient has two parts, one is $\Re$ independent of the temperature T , and the other is related to the temperature T.

Our goal is the principle of entropy increasing, which is the thermodynamic properties of matter particles. How the diffusion coefficient depends on temperature T? Which part is more important?

The material particles do Brownian motion under the random collision of STP. According to the estimation in Section 3.4, the most important physical parameter is the average time interval between two collisions τ as

$$\tau \approx 10^{-20} s \tag{12.38}$$

The time scale of electrons in quantum mechanics is $\tau \approx 10^{-16} s$.Therefore, the electrons in hydrogen atoms are much larger than the time scale of MIP. We will explicitly construct the average time interval τ into the equation of motion:

$$m\frac{dV}{dt} = -\frac{mV}{\tau} + F(t) \tag{12.39}$$

We are able to get the answers to the above two questions at the same time as follows: Multiply both sides of the equation by X, using

$$\frac{d(XV)}{dt} = V^2 + X\frac{dV}{dt} \tag{12.40}$$

We can get

$$m\frac{d(XV)}{dt} = mV^2 - \frac{mXV}{\tau} + F(t)X \tag{12.41}$$

Taking the average of both sides of the equation, at a temperature of T the average kinetic energy of the particles is

$$\frac{1}{2}m < V^2 >= \frac{1}{2}kT \tag{12.42}$$

Substitute

$$m\frac{d(< XV >)}{dt} = kT - m\frac{< XV >}{\tau} \tag{12.43}$$

Combined with the initial condition $X(t=0) = 0$, we solve this differential equation as

$$< XV >= \frac{kT\tau}{m}(1 - e^{-t/\tau}) \tag{12.44}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

and

$$< XV >= \frac{1}{2}\frac{d < X^2 >}{dt} \tag{12.45}$$

Solve another differential equation to get

$$< X^2 >= \frac{2kT\tau}{m}(t - \tau(1 - e^{-t/\tau})) \tag{12.46}$$

This result is very important because it has both the properties wanted:

1. Under very short time scale $t \ll \tau$

$$< X^2 >= \frac{kT}{m}t^2 \tag{12.47}$$

At this time scale, the particles are moving at a uniform linear velocity, which comes from thermal motion $\sqrt{\frac{kT}{m}}$.

2. More importantly, under the time scale observed in the experiment, $t \gg \tau$

$$< X^2 >= \frac{2kT\tau}{m}t = 2\Re_T t \tag{12.48}$$

It shows that at this time scale, the particles are diffusive. Compared with equation (12.37), we can calculate the ratio of the diffusion caused by thermal motion to the diffusion at absolute zero. Assuming the system at room temperature 300K, the ratio will be

$$\frac{\Re_T}{\Re} \approx 10^{-6} \tag{12.49}$$

Therefore, the results we obtained without considering the temperature effect are very good approximations. The diffusion effect of material particles due to thermal motion can be ignored, and the diffusion coefficient at absolute zero based on MIP calculation is very accurate. In MIP, whenever considering quantum effects only, the entropy at finite temperature can be ignored, just as in the Schrödinger equation where is no need for a term directly related to temperature.

e) *Proof of entropy increasing principle*

Within the framework of MIP, we can use the definitions of entropy, combining with the general nature of Markov process, to prove the entropy increasing principle for non-interacting particle, both at finite temperature and absolute zero.

$$S = -\sum_i p_i \log p_i \tag{12.50}$$

Straightforwardly, proving the entropy increasing principle means

$$\frac{dS}{dt} \geqslant 0 \tag{12.51}$$

Use the definition of probability

$$\sum_i p_i = 1 \tag{12.52}$$

we have

$$\sum_i \frac{dp_i}{dt} = 0 \tag{12.53}$$

Then the definition of entropy goes to

$$\frac{dS}{dt} = -\sum_i (\frac{dp_i}{dt} \log p_i + \frac{dp_i}{dt}) = -\sum_i \frac{dp_i}{dt} \log p_i \tag{12.54}$$

If there is equal probability distribution, all p_i are equal to constant

$$p_i = \frac{1}{\Omega} \tag{12.55}$$

which is a very useful constraint. We will use it below.

The STP collision causes the transition between different states of material particles, which is a Markov process. For the Markov process, the following mathematical properties

$$\frac{dp_i}{dt} = \sum_j (p_j - p_i) g_{ij} \tag{12.56}$$

$$\frac{dp_j}{dt} = \sum_i (p_i - p_j) g_{ji} \tag{12.57}$$

This property has already been used in Section 3.3 equation (3.23), which is a special case of this mathematical property. If the probability distribution is equal, the probability no longer changes. It is an important step to prove that the collision of STP is invariant in time reversal, requiring the transfer matrix g to have

$$g_{ij} = g_{ji} \geqslant 0 \tag{12.58}$$

Therefore, the transition between various states is reversible on the time scale of STP collision, because the matter particle's Brownian motion in spacetime is frictionless. The proof of entropy increasing principle is irrelevant about the specific expression of entropy, whether or not including the temperature T. From this microscopic reversibility, it is possible to deduce the irreversibility of entropy on the macroscopic time scale, which is the essence point.

With this mathematical property, we get

$$\frac{dS}{dt} = -\frac{1}{2}(\sum_i \frac{dp_i}{dt} \log p_i + \sum_j \frac{dp_j}{dt} \log p_j)$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

$$= -\frac{1}{2}(\sum_{ij}(p_j - p_i)g_{ij}\log p_i + \sum_{ij}(p_i - p_j)g_{ji}\log p_j)$$

$$= \frac{1}{2}\sum_{ij}(p_j - p_i)g_{ij}(\log p_j - \log p_i) \tag{12.59}$$

If $p_j \geqslant p_i$, then $\log p_j \geqslant \log p_i$, which guarantees $\frac{dS}{dt} \geqslant 0$.

If $p_j \leqslant p_i$, then $\log p_j \leqslant \log p_i$, which also guarantees $\frac{dS}{dt} \geqslant 0$.

So the entropy increasing principle has been proved. This principle has profound significance in physics and other scientific fields, and can be used as a criterion for irreversibility and time flow. However, it must be emphasized that this principle is still an empirical law in modern physics and cannot be explained from the first principle. Therefore, our results are of great significance. In MIP, the random collision of STP can naturally generate the fundamental principle of increasing entropy. Within the framework of MIP, we unify the concept of entropy both at finite temperature and absolute zero and prove that both types of entropy are never decreasing with time.

f) Why did nature choose Brownian motion?

In the previous section, we generally proved the principle of entropy increasing. Now let us use the properties of Brownian motion to calculate the entropy of free particles quantitatively. From this we can see how entropy increases over time in the framework of MIP. we taking the state label i as the particle coordinate x, then the definition of particle entropy can be written as

$$S = -\int dx p(x)\ln p(x) \tag{12.60}$$

With the mathematical properties of Brownian motion of free particles, we know that the probability distribution is

$$p(x) = \frac{1}{\sqrt{2\pi\sigma^2}}e^{-\frac{(x-\mu)^2}{2\sigma^2}} \tag{12.61}$$

Where μ is the initial position of the free particle (it can also be set to zero, the result has nothing to do with the initial position), and the variance of the particle coordinates is

$$\sigma^2 = 2Rt \tag{12.62}$$

where R is our diffusion coefficient as

$$R = \frac{h}{2m_{ST}} \tag{12.63}$$

Substituting the specific expression of the above probability distribution into the definition of entropy, we get

$$S = \frac{1}{2}(1 + \ln(4\pi Rt)) \tag{12.64}$$

Because the logarithmic function is a monotonically increasing function, we have obtained the specific expression of entropy increasing quantitatively. Mathematically speaking, there are many types of random motion. Even given a mean and a variance at a certain moment as

$$\int dxxp(x) = \mu \tag{12.65}$$

$$\int dx(x-\mu)^2 p(x) = \sigma^2 \tag{12.66}$$

There are still infinitely many types of probability distribution p(x), and each probability distribution p(x) corresponds to a specific kind of random motion, that is, there are infinitely many types of random motion. Why does nature choose the type of Brownian motion due to STP randomly colliding with material particles? There is a good answer to this question under the framework of MIP: when a material particle chooses Brownian motion, its entropy happens to be the largest, which is greater than any other probability distribution p(x). The proof is given as following. According to the definition of entropy, under the two constraints of mean and variance, the functional form of p(x) is determined so that S can be maximized, which is a variational problem in mathematics. With two constraints, we introduce two Lagrange multipliers Λ_0 and Λ as

$$L = \int_{-\infty}^{\infty} p(x)\ln(p(x))\,dx - \Lambda_0\left(1 - \int_{-\infty}^{infty} p(x)\,dx\right) - \Lambda\left(\sigma^2 - \int_{-\infty}^{\infty} p(x)(x-\mu)^2\,dx\right) \tag{12.67}$$

Let its variation be 0 as

$$\delta L = \int_{-\infty}^{\infty} \delta p(x)\left(\ln(p(x)) + 1 + \Lambda_0 + \Lambda(x-\mu)^2\right)\,dx = 0 \tag{12.68}$$

Which leads to

$$p(x) = e^{-\Lambda_0 - 1 - \Lambda(x-\mu)^2} \tag{12.69}$$

Substituting two conditions of constraints, we can determine two Lagrange multipliers to get the final result as

$$p(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \tag{12.70}$$

This happens to be the probability distribution of Brownian motion. Q.E.D.

Substituting p(x) into the definition of entropy, we get

$$S = \frac{1}{2}(1 + \ln(2\pi\sigma^2)) \tag{12.71}$$

At any given moment, choosing this special random motion precisely maximizes the entropy of material particles. This random movement is the most disorder and unpredictable. We can clearly say that STP randomly collides with material particles, so that the material particles choose Brownian motion, which is not accidental at all. Furthermore, with time evolving, we have

$$\sigma^2 = 2Rt \tag{12.72}$$

The entropy of material particles increases monotonically with time until reaching the relaxation time of the system. At the relaxation time, the system reaches an equilibrium state, which is the state of maximum entropy. The entropy no longer increases.

g) Summary

Entropy is a concept of fundamental importance in physics and has significant applications in many fields of physics. The concept of entropy is introduced because of its special properties, the most important of which is the law of entropy increasing. However, it must be noted that the law of entropy increasing is still an empirical law in the current framework of physics. This law is summarized from countless experiences in the real world, which cannot actually be proved from the first principle. It can be clearly seen from the mathematical definition of entropy that entropy depends on the probability of each state. Therefore, entropy is a characterization of random events. The modern physics framework does not fully understand the origin of the random motions of microscopic material particles. The MIP proposed in this article fundamentally explains the reason why material particles move randomly, that is, the random collision of STP. In this new picture, we go beyond the framework of modern physics and are able to provide a proof of the law of increasing entropy. This key proof is extremely important for the concept of entropy, and is equally important for the MIP proposed by this article. Proving the law of entropy increasing under the MIP framework is in itself a strong support for MIP. At the same time, in the process of proof, we discovered the underlying reason why nature chooses material particles to perform Brownian motion. This special type of random motion has many wonderful properties, which is not only the cornerstone of the microscopic explanation of quantum mechanics, but also the root of the second law of thermodynamics.

XIV. Summary

Starting from the fundamental concept innovation of statistical mass, this paper proposes MIP: material particles will be subjected to random collision of STP's which is ubiquitous in spacetime to make frictionless Brownian motion. The change of the action of material particles in each collision is integer multiple of Planck constant h. From MIP, we can prove all the important results of quantum theory. The quantum theory obtained within the framework if MIP is fully compatible with the existing quantum theory. The advantage of this new framework is that it does not require the introduction of additional wave function assumptions, and is able to derive the Schrödinger equation directly. In particular, the concept of wave pack collapse is not required to be introduced under our MIP framework. The Heisenberg uncertainty principle no longer has a fundamental position but a natural inference under the MIP framework. From the statistical uncertainty between inertial mass and spacetime diffusion coefficient, the most basic coordinate momentum uncertainty relationship of quantum mechanics can be derived. Therefore, it is proved that the wave-particle duality is a property exhibited by the STP colliding particles under the MIP framework. Furthermore, we apply MIP to quantum measurement problems, and have a new breakthrough interpretation of the EPR paradox problem that has confused physics for nearly a century. The STP colliding matter particles is a zero-spin scalar particle without mass. According to MIP, the topological properties and dynamic properties of STP can explain the nature of photons, and thus naturally obtain the complete electromagnetic theory and all important properties of charge. More importantly, the classical electromagnetic theory we have obtained is completely applicable in the microscopic world. Combined with Brownian motion at the underlying level of the microscopic world, classical electromagnetic theory can prove that the accelerated motion of free electrons and electrons outside the nucleus do not cause electromagnetic radiation, thus truly solving the problem of atomic stability for the first time.

Furthermore, from the vortex structure of spacetime, we obtain the origin of the spin and the relationship between spin and mass. Going back to the 2+1d vortex when we investigate the electromagnetic fields in 3+1d spacetime, we prove the strong constrain on the number of generations of charged leptons, at most three generations.

Due to the random collisions between STP and matter particles, matter particles are able to behave exactly as requiered by the postulations of quantum mechanics, which shows that STP is the supervisor and shepherd for all the microscopic behaviors of matter particles, MIP also creates the foundation for further investigation on the completeness problem of quantum mechanical descriptions.

Last but not least, MIP requires a novel massless scalar particle STP. The random collision between STPs and muons is the crucial step beyond standard model. Our extension of standard model is minimal, which only introduce on free parameter decribing the interaction strength between STPs and muons, then we are able to explain two key experiments of muon simultaneously. By thorough calculations of corresponding Feyman's diagrams, the contributions from random collisions between STPs and muons explain the anomalous magnetic moment of muon and its lifetime excellently, which solve a world class puzzle about the anomalous magnetic moment of muon, and give a self-consistent explanation to the lifetime discrepancy of muon at the same time. Recent experomental results from FermiLab are the most precision verfication of MIP, which guarantee the correctness of MIP and the advantages over other alternative theories. Finally, starting from MIP, we produce the entropy of material particles at the microscopic level, establish the corresponding concept of entropy at absolute zero and unify the entropy at absolute zero and the entropy at finite temperature. Furthermore, we prove the principle of entropy increasing in the non-interacting particle systems.

In summary, MIP is the origin of quantum mechanics. MIP is able to revise standard model at minimal cost to explain the anomalous magnetic moment of muon, which provides a whole new framework to research phenomena beyond standard model.

Appendix A: Brown Motion and Markov Process

When the displacement of the material particle $X(t)$ satisfies the following conditions, we call the material particle doing Brownian motion:

$$1.X(0) = 0.$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

2. On any finite disjoint interval set $(s_i, s_i + t_t)$, the displacement of the particle is $X(s_i + t_t) - X(s_i)$, which are random variables that are independent of each other.

3. For each $s \geqslant 0, t \geqslant 0$, $X(s+t) - X(s)$ obeys the normal distribution $N(0,t)$.

For each constant a, the process $X(t) + a$ is called the Brownian motion starting from a. For the Brownian motion that is physically free of friction, we call it the Brownian motion in this paper.

Consider any past set of times $(\cdots, p_2, p_1)$, any "current time" s, and any "future time" t, all of which are within the range of X, if any

$$\cdots < p_2 < p_1 < s \tag{13.1}$$

Then the Markov property is established, and the process is a Markov process, but only if:

$$\begin{aligned}\Pr\left[X(t)\right. &= \left. x(t) \mid X(s) = x(s), X(p_1) = x(p_1), X(p_2) = x(p_2), \ldots\right] \\ &= \Pr\left[X(t) = x(t) \mid X(s) = x(s)\right]\end{aligned} \tag{13.2}$$

Set up for all time sets. Then calculate the conditional probability

$$\Pr\left[X(t) = x(t) \mid X(s) = x(s), X(p_1) = x(p_1), X(p_2) = x(p_2), \ldots\right] \tag{13.3}$$

Future state is independent of any historical state and is only relevant to the current state.

In summary, the Brownian motion studied in this paper is a Markov process.

Appendix B: Decomposition of Random Variables

In the Langevin equation, the true velocity of particle motion $\vec{V}$ contains three parts: the classic statistical velocity $\vec{v}$, quantum envelope velocity $\vec{u}$ and Gaussian noise $\vec{\nu}$

We do not consider the impact of classic statistical velocity. Then the random motion of the particles will be determined by the quantum envelope motion and Gaussian noise. The fact that we need to prove is that we can distinguish the quantum envelope motion $\vec{u}$ in the strict mathematical differential sense. The quantum envelope motion corresponds to the smooth continuous part of the random motion, and the Gaussian noise corresponds to the continuous non-differentiable part of the random motion.

First, for any random variable $r(x,t)$, if a smooth function $f(x,t)$ is superimposed, the result is still a random variable. which is a random variable, as

$$w(x,t) = r(x,t) + f(x,t) \tag{13.4}$$

But if $r(x,t)$ or $w(x,t)$ has a finite order autocorrelation association, then theoretically we can strictly distinguish $w(x,t)$ and other two random variables of $r(x,t)$, which is:

$$\langle r(x_1,t_1)r(x_2,t_2)\cdots r(x_n,t_n)\rangle_r = \mathcal{F}_n(\vec{x},\vec{t}), \quad mod(n,N) \equiv 0 \tag{13.5}$$

$$\langle r(x_1,t_1)r(x_2,t_2)\cdots r(x_n,t_n)\rangle_r = 0, \quad mod(n,N) \neq 0 \tag{13.6}$$

Then there is

$$\langle w(x_1,t_1)w(x_2,t_2)\cdots w(x_N,t_N)\cdots w(x_n,t_n)\rangle_r \neq 0, \quad n > N \tag{13.7}$$

Therefore, it can be strictly distinguished mathematically. In the case we considered, Gaussian noise $\vec{\nu}$ has a second-order correlation

$$\langle \nu_i(t)\nu_j(t')\rangle = \Omega\delta_{i,j}\delta(t-t') \tag{13.8}$$

And all odd-order associations are zero

$$\langle \nu(t)\rangle_\nu = 0$$

So obviously

$$\vec{w}(t) = \vec{u}(t) + \vec{\nu}(t)$$

The odd-order correlation is not zero. So you can strictly distinguish between $\vec{w}(t)$ and $\vec{\nu}(t)$. Due to the MIP, there is only one kind of Gaussian noise, and there is no other noise source. So continuous functions other than noise are smooth and differentiable functions. So $\vec{u}$ is a smooth function.

Appendix C: Additional Physics Example with Three Speed Decomposition

The superposition of orbitals and the formation of chemical bonds, which are common in chemistry, involves quantum superposition states. In the simplest case, the ground state of the hydrogen atom and the first excited state are superimposed with equal probability as

$$\psi(r,t) = \psi_{100}e^{-iE_1t} + \psi_{200}e^{-iE_2t} \tag{13.9}$$

Where $E_1 = -13.6ev, E_2 = -13.6/4ev = -3.4ev$, the wave function of the ground state of the hydrogen atom and the first excited state are

$$\psi_{100} = \frac{1}{\sqrt{\pi a^3}}e^{-r/a} \tag{13.10}$$

$$\psi_{200} = \frac{1}{\sqrt{2a^3}}e^{-r/2a}(1-\frac{r}{2a}) \tag{13.11}$$

Where a is the Bohr's radius $a = 0.529 \times 10^{-10}m$.

With the Euler formula, we can write the superimposed wave function as

$$\psi = [\psi_{100}cos(E_1 t) + \psi_{200}cos(E_2 t)] - i[[\psi_{100}sin(E_1 t) + \psi_{200}sin(E_2 t)] \tag{13.12}$$

From the real and imaginary part, the two potential functions R and I of the superposition wave function can be further determined. It is found by equation (5.34) and (5.35) that the electrons u and v are not zero in this state.

This physics example is not a special case, and has general physical meaning. When the quantum state has definite energy, its classical statistical velocity v must be zero. Generally speaking, the particle is in the superposition state of the energy eigenstate, and its three speeds are not zero which has clear physical meaning.

Appendix D: From MIP to the Uncertainty Principle

We believe that the uncertainty principle comes from the kinematic equation of stochastic spacetime motion, which is rooted in the non-differentiable motion path, i.e. the particle coordinate $\vec{x}(t)$ derivative of time $d\vec{x}/dt$ does not exist. Therefore, it must be noted that the particle's momentum $\vec{p} = md\vec{x}/dt$ cannot be well defined. The momentum is defined as follows

$$\vec{p} = mD\vec{x} = m\vec{v} + m\vec{u} \tag{13.13}$$

Kinematic equation

$$\vec{u} = \Re\frac{\nabla\rho}{\rho} \tag{13.14}$$

For the sake of simplicity, the following discussion uses only one component in the x direction, and all vector equations become equations of one component. For any random variable O, the statistical average is $< O >= \int O\rho(x)dx$. Multiplying both sides of the equation by ρ and integrate x, we can get the x and u_x covariance

$$\sigma(x, u_x) =< (x- < x >)(u_x- < u_x >) >= -\Re \tag{13.15}$$

The covariance represents the total error of two variables, which is different from the variance that only represents the error of one variable. If two variables change in the same directions, then the covariance between two variables is positive. If two variables change in opposite directions, the covariance between two variables is negative. For any two real random variables A and B, there is the Schwarz inequality $|\sigma(A, B)| \leqslant \sigma(A)\sigma(B)$, which leads to

$$\sigma(x)\sigma(u_x) \geqslant \Re = \hbar/2m \tag{13.16}$$

The statistical definition of uncertainty is

$$\sigma(x) = \sqrt{< x^2 > - < x >^2} \tag{13.17}$$

$$\sigma(u_x) = \sqrt{< u_x^2 > - < u_x >^2} \tag{13.18}$$

So far we have proved the uncertainty relationship between the position of random spacetime moving particles and the fluctuation speed. Further, if the uncertainty of momentum has two parts of contributions

$$\sigma^2(p) = m^2(\sigma^2(v) + \sigma^2(u)) \tag{13.19}$$

That is, $\sigma(p) \geqslant m\sigma(u)$, the uncertainty of the position and the fluctuation speed can be obtained.

$$\sigma(x)\sigma(p_x) \geqslant \hbar/2 \tag{13.20}$$

The proof of our paper interprets Heisenberg's uncertainty principle as the uncertainty relationship between random spacetime moving particle position and fluctuation speed.The random spacetime motion has no friction and no irreversible dissipation.

The uncertainty of the fluctuation speed is entirely from spacetime fluctuations. According to Heisenberg's original statement, the measured action inevitably interferes with the state of the particles being measured, thus creating uncertainty. Later that year, Kennard gave another statement. The following year, Herman also obtained this result independently. According to Kennard's statement, the uncertainty of position and the uncertainty of momentum are the nature of the particle, and cannot be suppressed below a certain limit, regardless of the measured action. Thus, for the principle of uncertainty, there are two completely different interpretations. Landau believes that the two interpretations are equivalent, so one expression can be derived from another expressions (Ref. quantum mechanics of Landau). However, in the latest experimental progress, Japanese scholars published on January 15, 2012, the empirical results of the Heisenberg uncertainty principle. They used two instruments to measure the spin angle of the neutron and obtained a smaller measurement than the Heisenberg limit, which proves the measurement interpretation by Heisenberg is wrong. However, the principle of uncertainty is still correct, because this is the quantum nature of the particle.

The derivation process of this paper has nothing to do with the measurement theory, and it has nothing to do with the internal properties of the particles. It is believed that the uncertainty principle is rooted in the fluctuation of spacetime. Under the non-relativistic framework, spacetime fluctuations are only related to the mass of the particles. The mass of a particle is the only perceptible property of the particle in spacetime.

Appendix E: Self Isomorphism on Direct Product Spin Clusters

We hope to prove the following conclusions in this appendix:

Theorem 2: Given any topological excited state deformation: $A : \Lambda_L \otimes \Lambda_R \mapsto \Lambda_L \otimes \Lambda_R$, where A For automorphism mapping, Λ_L, Λ_R represent the left-hand spin cluster and the right-hand spin cluster, respectively, and A is the vector map.

Proof: First of all, from the symmetry of the spin structure, it is not difficult to know that we only need to prove arbitrary automorphism: $A : \Lambda_L \mapsto \Lambda_L$ Both are vector maps. This is because if we can determine that A is a vector map, we can get it through conjugate expansion: $\widetilde{A} : \Lambda_L \otimes \Lambda_R \mapsto \Lambda_L \otimes \Lambda_R$ for vector mapping.

To prove that any automorphism: $A : \Lambda_L \mapsto \Lambda_L$ is a vector map, we need to consider the model on the left-handed spin sector, which is corresponding to the $Clifford$ algebra .Proposition 1.3.2 by [45] It can be seen that for the finite form $Clifford$ algebra, the following forms are isomorphic:

$$Cl_{r,s} \cong Cl_1 \,\widehat{\otimes} ... \,\widehat{\otimes}\, Cl_1 \widehat{\otimes}\, Cl_1^* ... \,\widehat{\otimes}\, Cl_1^*.$$

Among them, the number of Cl_1 corresponds to r, and the number of Cl_1^* corresponds to s.

From the theorem 1.5.4 of [45], all $Clifford\ K-$ means that ρ can be decomposed into straight sums of irreducible algebra representations of the following form:

$$\rho = \rho_1 \oplus ... \oplus \rho_m.$$

The feature subspace W_i corresponding to ρ_i is the smallest subspace.

In additions, by the $Bott$ cycle law theorem [45], we can get the algebraic representation of all Cl_m, $(m = 1, ...8)$, and the representation follows the indicator m Repeated with a period of 8. That is: we can get the algebra of any Cl_m as follows:

$$Cl_1 = \mathbb{C},\ Cl_2 = \mathbb{H},\ Cl_3 = \mathbb{H} \oplus \mathbb{H},\ Cl_4 = \mathbb{H}(2),$$

$$Cl_5 = \mathbb{C}(4),\ Cl_6 = \mathbb{R}(8),\ Cl_7 = \mathbb{R}(8) \oplus \mathbb{R}(8),\ Cl_8 = \mathbb{R}(16). \tag{13.21}$$

For any combination of the above forms, the straight and broken parts ρ_i Can be split into direct product form:

$$Cl_{r,s} \cong\ Cl_1 \,\widehat{\otimes} ... \,\widehat{\otimes}\, Cl_1 \,\widehat{\otimes}\, Cl_1^* ... \widehat{\otimes}\, Cl_1^*.$$

The automorphism mapping between any part of the above direct product form can be made by $Cl_1 = \mathbb{C}, ...Cl_8 = \mathbb{R}(16)$ Algebraic combination between parts. Since the above parts are all vector spaces, the automorphism must be a vector mapping, that is, the automorphism of ρ_i must correspond to the matrix form.

In addition, from the algebraic decomposition process described above, it is not difficult to know that the homomorphic mapping between all corresponding different sub-blocks is also a vector mapping. Finally, we will be ρ_i, $i = 1, ...8$ All of them are combined together in a straight form, and we can get the automorphism $A : \Lambda_L \mapsto \Lambda_L$ when $i = 1, ...8$ for vector mapping. When the indicator i is greater than 8, by the $Bott$ cycle law, we can still get the automorphism mapping by the above process. A is the vector map. The conclusion is proved.

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

Appendix F: Field Theory Calculations for Fermionic Loop Integral

We consider the following Fermion loop momentum integrals

$$\int \frac{d^d k}{D_1^{n_1} D_2^{n_2}} = i\pi^{d/2}(-p^2)^{d/2-n_1-n_2} G(n_1, n_2)\,, \quad D_1 = -(k+p)^2\,, \quad D_2 = -k^2 \tag{13.22}$$

Noting that in the denominator, D_1, D_2 should actually have an infinitesimal analytic continuation $(-i0^+)$. But for the sake of simplicity, we don't explicitly write it out. After analysing the continuation, we need to consider the contribution of $p^2 < 0$, and the power contribution of $-p^2$ can be easily obtained from dimensional analysis. In fact, what needs to be calculated now is the dimensionless function $G(n_1, n_2)$; to simplify the calculation, we can let $-p^2 = 1$. When $n_1 \leq 0$ or $n_2 \leq 0$, the score can be strictly calculated and $G(n_1, n_2) = 0$ can be obtained.

Using Wick rotation and α parameterization, we can rewrite $G(n_1, n_2)$ as:

$$G(n_1, n_2) = \frac{\pi^{-d/2}}{\Gamma(n_1)\Gamma(n_2)} \int e^{-\alpha_1 (k+p)^2 - \alpha_2 k^2} \alpha_1^{n_1-1} \alpha_2^{n_2-1} d\alpha_1\, d\alpha_2\, d^d k\,. \tag{13.23}$$

Let

$$k' = k + \frac{\alpha_1}{\alpha_1 + \alpha_2} p\,,$$

We can get

$$\begin{aligned} G(n_1, n_2) &= \frac{\pi^{-d/2}}{\Gamma(n_1)\Gamma(n_2)} \int \exp\left[-\frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}\right] \alpha_1^{n_1-1}\alpha_2^{n_2-1} d\alpha_1\, d\alpha_2 \int e^{-(\alpha_1+\alpha_2)k^2} d^d k \\ &= \frac{1}{\Gamma(n_1)\Gamma(n_2)} \int \exp\left[-\frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}\right] (\alpha_1+\alpha_2)^{-d/2} \alpha_1^{n_1-1}\alpha_2^{n_2-1} d\alpha_1\, d\alpha_2\,. \end{aligned} \tag{13.24}$$

Using the substitution $\alpha_1 = \eta x$, $\alpha_2 = \eta(1-x)$, the above formula can be rewritten as

$$\begin{aligned} G(n_1, n_2) &= \frac{1}{\Gamma(n_1)\Gamma(n_2)} \int_0^1 x^{n_1-1}(1-x)^{n_2-1} dx \int_0^\infty e^{-\eta x(1-x)} \eta^{-d/2+n_1+n_2-1} d\eta \\ &= \frac{\Gamma(-d/2+n_1+n_2)}{\Gamma(n_1)\Gamma(n_2)} \int_0^1 x^{d/2-n_2-1}(1-x)^{d/2-n_1-1} dx\,. \end{aligned} \tag{13.25}$$

The integrand is an Euler B function, so we can get the final result

$$G(n_1, n_2) = \frac{\Gamma(-d/2+n_1+n_2)\Gamma(d/2-n_1)\Gamma(d/2-n_2)}{\Gamma(n_1)\Gamma(n_2)\Gamma(d-n_1-n_2)}\,. \tag{13.26}$$

Global Journal of Science Frontier Research (A) XXIV Issue III Version I Year 2024

For all positive integers $n_{1,2}$ they are proportional to

$$G_1 = G(1,1) = -\frac{2g_1}{(d-3)(d-4)}\,, \quad g_1 = \frac{\Gamma(1+\varepsilon)\Gamma^2(1-\varepsilon)}{\Gamma(1-2\varepsilon)}\,, \tag{13.27}$$

The scale factor is a rational function of d.

Noting that at $k \to \infty$, the denominator part of (13.22) behaves as $(k^2)^{n_1+n_2}$. Therefore, this integral is divergent when $d \geq 2(n_1+n_2)$.

Acknowledgement

Special thanks to Dr. Yu Xiaolu, Dr. He Yali and Dr. Wu Jianfeng for their patient discussions and critical suggestions. In addition, Dr. Song Fei has made important contributions to the certification of Appendix E of this paper. At the beginning of this research project, Dr. Zhang Peng, Dr. Ma Mingwei, Dr. Liu Jinyan, Dr. Tian Yuan, Cui Ying, and Hu Xiaohui also participated in the discussion and made many meaningful suggestions. I would like to thank them all.

XV. Data Avalability Statement

I claim that data in this article is openly available in a public repository.

References Références Referencias

[1] L. Erdos, Lecture Notes on Brownian Motion, arXiv: 1009.0843, (2010)

[2] N. Wiener, Differential space. J. Math and Phys. 58 , 131-174 (1923)

[3] J. Zinn-Justin, Quantum Field Theory and Critical Phenomena (4-th edition), Oxford University, (2002)

[4] S. Ross, A First Course in Probability (8th Edition), Pearson Prentice Hall, (2009)

[5] F. Reif, Fundamentals of Statistical and Thermal Physics, Waveland, (2009)

[6] A. Einstein, Investigations on the theory of the brownian movement. Dover Edition(1956).

[7] E. Nelson, Dynamical theories of Brownian motion, (Princeton University Press, Princeton, 1967).

[8] E. Nelson, Quantum Fluctuations, (Princeton University Press, Princeton, 1985).

[9] P.Dirac, Quantised Singularities in the Electromagnetic Field, Proc. Roy. Soc. A 133, 60 (1931)

[10] G. E. Uhlenbeck and L. S. Ornstein, Rev. Mod. Phys., 36,823(1930)

[11] M. C. Wang and G. E Uhlenbeck, Rev. Mod. Phys., 17,323(1945).

[12] L. de Broglie, C.R. Acad. Sci. 264B, 1041 (1967).

[13] M. Davidson, Lett. Math. Phys. 3, 271 (1979).

[14] M. Davidson, Lett. Math. Phys. 3, 367 (1979)

[15] Max Born, Zur Quantenmechanik der Sto vorg nge, Zeitschrift f'r Physik, 37, #12 (Dec. 1926), pp. 863-C867 (German); English translation, On the quantum mechanics of collisions, in Quantum theory and measurement, section I.2, J. A. Wheeler and W. H. Zurek, eds., Princeton, New Jersey: Princeton University Press, 1983, ISBN 0-691-08316-9.

[16] L. Kadanoff , Statistical Physics: statics, dynamics and renormalization. World Scientific Press, (2000).

[17] L. Landau and E. Lifshitz , Courses in theoretical physics, vol 1, Mechanics. Butterworth-Heinemann. (1976)

[18] H. Goldstein, Classical Mechanics (3rd Edition), Addison-Wesley, (2001).

[19] J. D. Jackson, Classical Electrodynamics (3-rd Edition), Wiley, (1998)

[20] L. Landau and E. Lifshitz , Courses in theoretical physics, vol 3, Quantum Mechanics. Pergamon Press, (1977)

[21] R.J. Glauber, Quantum optics and electronics, edited by C. De Witt (Gordon-Breach New York, 1965); H. Haken, in Encyclopedia of Physics (Springer, New York, 1976).

[22] G. Birkhoff and J. von Neumann, Ann. Math. 37, 823 (1932).

[23] H. Haken and W. Weidlich, Z. Phys. 205, 96 (1967).

[24] Einstein, A; B Podolsky; N Rosen. Physical Review. 47 (10): 777-780.

[25] R. P. Feynman, Ph.D thesis. Princeton Press (1942).

[26] P.A.M. Dirac, Physikalische Zeitschrift der Sowjetunion, Band 3, Heft 1 , pp. 64-72 (1933).

[27] L. Mario. "Hydrodynamic theory of electromagnetic fields in continuous media." Physical Review Letters 70.23(1993):3580-3583.

[28] Martins, Alexandre A , Pinheiro, et al. Fluidic electrodynamics: Approach to electromagnetic propulsion[C] Aip Conf Proc. American Institute of Physics, 2009.

[29] S. Weinberg, The Quantum Theory of Fields, vol 2, Cambridge University, (1995)

[30] Martin, T.. (1976). Torsion and the geometry of spin.

[31] Jackiw R , Weinberg S . Weak-Interaction Corrections to the Muon Magnetic Moment and to Muonic-Atom Energy Levels. Phys. Rev. D. 5, 2396 (1972).

[32] G. Bennett et al. (Muon g-2 Collaboration), Final Report of the Muon E821 Anomalous Magnetic Moment Measurement at BNL, Phys.Rev. D73, 072003 (2006).

[33] B. Abi, et al. Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm, Phys. Rev. Lett. 126 (14) (2021) 141801.

[34] V. A. Smirnov, Feynman Integral Calculus, (Springer Verlag, Berlin, 2006) DOI: https://doi.org/10.1007/3-540-30611-0.

[35] I. Dubovyka , J. Gluza and T. Riemann, Optimizing the Mellin-Barnes Approach to Numerical Multiloop Calculations. Acta Physica Polonica B, Vol. 50 (2019), 11, 1993.

[36] AMBRE webpage: http://prac.us.edu.pl/˜gluza/ambre.

[37] J. Gluza, K. Kajda, T. Riemann, AMBRE - a Mathematica package for the construction of Mellin-Barnes representations for Feynman integrals, Comput. Phys. Commun. 177 (2007) 879–893. arXiv:0704.2423, doi: 10.1016/j.cpc.2007.07.001.

[38] A. Smirnov, V. Smirnov, On the Resolution of Singularities of Multiple Mellin-Barnes Integrals, Eur. Phys. J. C62 (2009) 445–449. arXiv: 0901.0386, doi:10.1140/epjc/s10052-009-1039-6.

[39] P. A. Zyla et al.(Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020) and 2021 update

[40] Keshavarzi, Alex and Khaw, Kim Siang and Yoshiokam Tamaki. (2021). Muon $g-2$: current status.

[41] Aoyama, Tatsumi, et al. ”Revised and Improved value of the QED Tenth-Order Electron Anomalous Magnetic Moment.” Physical Review D, Vol. 97. no. 3, Feb. 2018. Crossref.

[42] R.H. Parker, C.Yu, W. Zhong, B. Estey, H. Muller, Measurment of the fine-structure constant as a test of the standard Model, Science 360 (2018) 191.

[43] Eidelman, M. Giacomini, F.V. Ignatov, M. Passera, The τ lepton anomalous magnetic moment, Nuclear Physics B - Proceedings Supplements, Volume 169, 2007, Pages 226-231, ISSN 0920-5632, https://doi.org/10.1016/j.nuclphysbps.2007.03.002. (https://www.sciencedirect.com/science/article/pii/S0920563207002496)

[44] CDF COLLABORATION, High-precision measurement of the W boson mass with the CDF II detector, SCIENCE, 376,(2022) 170

[45] H. B. Lawson. Spin Geometry [M]. Princeton University Press, New Jersey, 1994.

Global Journals Guidelines Handbook 2024

www.GlobalJournals.org

Memberships

FELLOWS/ASSOCIATES OF SCIENCE FRONTIER RESEARCH COUNCIL

FSFRC/ASFRC MEMBERSHIPS

Introduction

FSFRC/ASFRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FSFRC/ASFRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FSFRC

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefit

To the institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FSFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FSFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FSFRC or William Walldroff, M.S., FSFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FSFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career Financial

GJ Internal Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career Credibility Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows and associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career Credibility Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 60% of sales proceeds from the sale of reference/review books/literature/ publishing of research paper. The FSFRC member can decide its price and we can help in making the right decision.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

Access to Editorial Board

Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career Credibility Exclusive Reputation

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ASFRC

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

> The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

Benefit

To the Institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A ASFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Associates can use the honored title of membership. The “ASFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ASFRC or William Walldroff, M.S., ASFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Associate members of ASFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All associates get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Associates receive discounts on the future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Internal Account

Unlimited forward of Emails

Associates get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows receive access to almost all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento **2** discounted publishing/year **Gradation** of Research **10** research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- o You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- o Give details of all of your remarks as much as possible, focusing on mechanisms.
- o Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- o One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- o Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

Index

save our planet

Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896