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Unraveling the Quantum Web: The Vortex Theory of Mass and Matter Formation

Nader Butto

Dgania, Petah Tikva, Israel
Email: nader.butto@gmail.com

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Abstract

Mass plays a role in many physical phenomena, including the behavior of subatomic particles, the formation and behavior of stars and galaxies, and gravitational interactions between objects. The density of vacuum, 9.5×10^{-27} kg/m^3, is a crucial parameter in the theory of cosmic inflation and is responsible for the accelerated expansion of the universe in its early stages. This vacuum energy interacts with matter and manifests itself as mass, which can be described as flow and vortex formation using the laws of hydrodynamics. The vortex model of elementary particles, in conjunction with the laws of hydrodynamics, provides an elegant explanation for the origin of mass and the relationship between mass and energy, with profound implications for the behavior of objects at high velocities and strong gravitational fields. The vacuum behaves as a compressible superfluid, thus elementary particles can be described as vortices of the vacuum. The equations of hydrodynamics for vortices can be applied to describe the nature and value of the mass of particles. The implications of understanding the nature of mass are vast and profound. From elucidating the fundamental properties of particles to informing the design of advanced materials and technologies, this knowledge is indispensable. It drives advancements across numerous fields, transforming both our theoretical understanding and practical capabilities. Continued research into the nature of mass promises to unlock further insights, fostering innovation and expanding the frontiers of science and technology.

Keywords

Dark Energy, Dark Matter, Vacuum, Mass, Subatomic Particles, Cosmic Inflation, Virtual Particles, Vortex Formation, Hydrodynamics, Density

1. Introduction

Mass is one of the central and most fundamental concepts in physics and cosmology. It refers to the amount of matter an object possesses and plays a crucial role in shaping the behavior of everything from subatomic particles to entire galaxies. Despite its importance, the nature of mass remains shrouded in mystery, and scientists still wrestle with some of the most fundamental questions about this elusive property. Mass can be measured in terms of various phenomena, including inertial mass, rest mass, invariant mass, active gravitational mass, and passive gravitational mass. While some theorists have speculated that these measurements may be independent of each other, recent experiments have found no difference in the results regardless of how mass is measured. Repeated experiments since the 17th century have shown that inertial mass and gravitational mass are identical. Since 1915, this observation has been incorporated a priori into the equivalence principle of general relativity. Newton believed that mass is a fundamental property of matter and that it can be measured by its density and volume. He also believed that mass is a key factor in determining an object's resistance to acceleration and that gravity is a real force that can explain the motions of celestial bodies. Beyond these observations, however, he did not speculate about the nature or essence of mass. Einstein's view of the nature of mass can be summarized in his famous equation $E = mc^2$, which relates energy and mass. According to Einstein's theory of relativity, mass and energy are two forms of the same thing and can be converted into each other. In other words, mass is a measure of the energy contained in an object. However, Einstein's famous equation describes the equivalence between energy and mass but does not explain how energy actually transforms into mass. Thus, while we understand how mass behaves in the presence of gravity, we don't fully understand what mass is at a fundamental level. Special relativity provides a rational and logical description of particle physics in which masses exist independently of an observer and relativistic corrections are used to provide a description independent of the observer's velocity.

However, special relativity cannot provide a physical explanation for the existence of mass particles. Furthermore, according to the theory of general relativity, mass is what curves the spacetime fabric and causes objects to move towards each other under the force of gravity. In this way, mass is intimately connected to the geometry of space, and the distribution of matter and energy in the universe determines the curvature of spacetime, which in turn governs the behavior of objects moving within it. However, a fundamental question arises: where does the energy, known as mass, responsible for this curvature actually come from? In the realm of particle physics, we've identified particles as the building blocks of matter. Yet, the origin of the mass associated with these particles remained undefined for a long time. In essence, there was a gap in our understanding. We knew that mass was essential for the gravitational interactions described by general relativity, but the source of this mass remained elusive. It was a quantum mystery. This concept raises profound questions about the nature of particles, mass, and their relationship to the curvature of spacetime. It challenges us to delve deeper into the fundamental workings of the universe to uncover the origins of mass and, by extension, the forces that shape the cosmos. In quantum mechanics, mass is described in terms of wave equations and point particles, with energy concentrated at a mathematical point. However, it is difficult to find a logical definition of quantum mechanics as a physical theory, and it is uncertain whether the concept of mass has any physical meaning at all. At the scale of the proton nucleus, we observe incredibly strong confining forces. According to the principles of general relativity, these forces should require an enormous amount of energy or mass to produce. Surprisingly, early quantum field theory (QFT) predictions indicated the existence of extremely high energy levels, referred to as the "bare mass" of particles. In quantum field theory, particles are considered to interact with various fields, such as electromagnetic or strong nuclear fields, and these interactions can modify the mass of a particle from its bare mass. However, when physicists perform calculations in quantum field theory, they often encounter divergent or infinite quantities related to the bare mass. These divergences are problematic and need to be addressed. However, modern quantum electrodynamics (QED) and quantum chromodynamics (QCD) have since renormalized these predictions to yield finite and physically meaningful results. They achieve this by utilizing the concept of quantum vacuum fluctuations as a shielding mechanism [1].

Essentially, they create an environment around particles that reduces the effective energy or mass they exhibit to the outside world. In simpler terms, these fluctuations help reconcile the high energy levels predicted by QFT with the observed properties of particles, making them more consistent with real-world observations. The bare mass is the initial, uncorrected mass of a particle in the absence of these interactions.

In the Standard Model of particle physics, mass is a property of particles that results from their interaction with the Higgs field. The Higgs field is a fundamental field that permeates all of space and gives particles their mass.

On July 4, 2012, significant news emerged from the scientific community as the ATLAS and CMS experimental teams, conducting experiments at the Large Hadron Collider (LHC) located at CERN, unveiled the identification of an extraordinary and previously unknown particle. The outcomes of their research have since been documented and formalized in scientific publications, as referenced in papers [2] and [3].

However, despite this progress, many mysteries about mass remain and the Higgs mechanism is still not fully understood. For example, scientists still do not know why the masses of different particles vary so widely, or why the universe appears to be made mostly of matter rather than antimatter. Why is the Higgs field the only field that gives rise to mass? And why is the mass of the Higgs boson itself so much larger than the masses of other particles?

However, one of the most puzzling aspects of mass is the fact that it appears to arise from interactions between particles that are not themselves massive.

The Standard Model classifies elementary particles into families, generations, and classes according to the forces that hold them together, but the internal physical nature and structure of most fundamental particles, such as leptons and quarks, is not yet known.

These are just a few of the questions that physicists are trying to answer in their quest to understand the enigma of mass [4]. These questions continue to drive research in fields ranging from particle physics to astrophysics [5] [6].

Therefore, the three main theories of modern physics, quantum mechanics, special relativity, and the Standard Model, have been unable to provide a clear explanation of the physical nature or origin of mass.

This article comes to propose new concepts related to the formation and nature of mass. This can be considered as a continuation for the theory proposed in the recent years, to elucidate the nature and essence of particles such as electrons and photons and its relationship to vacuum density [7]-[12].

This article presents new ideas about the origin and composition of mass based on recent developments in particle physics. In particular, it proposes that elementary particles such as electrons and quarks derive their mass from the formation of vortices in a vacuum, creating a connection between the vacuum and matter. This theory is supported by mathematical calculations and has the potential to improve our understanding of fundamental physics.

2. Exploring the Pre-Big Bang Omniom

The concept of "before" the Big Bang is not clearly defined in current scientific models and theories of the universe. According to the Big Bang model, the universe began as a singularity, a point of infinite density and temperature, and expanded rapidly from that point. The model does not describe what happened before that point, nor does it predict what might have existed in a hypothetical state before the Big Bang.

The emergence of matter from nothing is said to have occurred through a combination of symmetry breaking and the process of cosmic inflation, in which the energy of the universe was transformed into matter over time. The exact details of these processes are still being explored, but they provide a powerful framework for understanding the origins of the universe as we know it today and the mechanism of mass formation.

When trying to understand what was before the Big Bang, it is important to distinguish between different concepts related to space, energy and matter.

According to the Big Bang theory, there was no space or time before the Big Bang, so the concept of vacuum as we understand it did not exist.

We can define vacuum as nothingness without space, energy, matter, radiation or other substances. While vacuum Energy is the energy associated with the quantum fluctuations of the vacuum in space. This energy is believed to be a property of space itself and is not associated with matter or radiation.

Quantum fields are theoretical constructs that describe how particles and forces interact, and they are considered fundamental entities in the universe. They consist of excitations or oscillations called particles or quanta, therefore they were formed after the big bang.

Dark energy is a hypothetical form of energy that is thought to be responsible for the observed acceleration of the expansion of the universe. Unlike vacuum energy, dark energy is not associated with the vacuum of space, but is thought to be a property of space itself.

Space is often described as a "container" that holds all objects and events. It is usually characterized by its properties such as size, shape, and dimensionality, which can be measured and studied using various physical tools and techniques. Thus the space appeared after the big bang.

Dark matter is a hypothetical form of matter that is thought to make up about 85% of the matter in the universe. Unlike normal matter, which interacts with light and other forms of radiation, dark matter is invisible and interacts only through its gravitational effects. Currently, there is no consensus on the composition of dark matter. Several theoretical models attempt to explain the nature of dark matter, but none has been definitively proven. Some models suggest that dark matter particles may consist of virtual particles that exist briefly due to quantum fluctuations but cannot be observed directly.

Therefore, the only thing that could exist before the big bang is the medium which has no movement, no energy no space or time is the vacuum itself that in order to distinguish it clearly other concepts of vacuum we could call it Omniom.

The Omniom is the primordial field made of bubble like structure, which behave collectively as a superfluid, where the electromagnetic radiation displaces and fluctuate this superfluid field. A superfluid means that it can flow like without friction or energy loss [13]-[15].

It is transparent to light and other electromagnetic waves, allowing them to pass through it with very small impedance presented as electric permittivity, magnetic permeability and gravitation constants G [16]-[18].

In the realm of quantum mechanics, there's a fundamental principle that nothing stays perfectly still, even empty space itself. This means that spacetime, the very fabric of the universe, is not static but subject to constant, tiny, and unpredictable fluctuations at incredibly small scales. These fluctuations are inherent to the quantum nature of the universe.

Imagine these quantum fluctuations as tiny, ever-changing bubbles or foam popping in and out of existence within the fabric of spacetime itself. This gives rise to what scientists call "quantum foam" or "spacetime foam". It's as though spacetime has a microscopic, turbulent structure due to these fluctuations.

The idea of spacetime foam dates back to the 1950s and cosmologist John Wheeler at Princeton University. Wheeler proposed that at the Planck scale, space would not be continuous, but foamy [19].

In essence, the concept of quantum foam suggests that even empty space is far from empty at the quantum level. It's teeming with activity, where spacetime itself experiences fluctuations akin to a bubbling foam. These fluctuations introduce an inherent uncertainty in our ability to measure distances accurately at the smallest scales. This intriguing aspect of quantum physics challenges our conventional notions of empty space as something completely devoid of activity. Instead, it reveals a dynamic and ever-changing nature of spacetime, even in its seemingly empty regions.

In this framework, there is a fundamental unit represents the smallest possible density associated with these soap-like particles which is considered to be indivisible and have some hypothetical properties associated with them. Just as soap bubbles minimize their surface area by adopting spherical shapes, these hypothetical particles interact to form bubble-like structures in space called omniom bubbles.

They are highly organized and coherent fluid-like state in a constant state of dynamic equilibrium. However, a key point is that this foam-like space is inherently not in a static, balanced state but continually evolves and adapts in response to various forces and conditions. Simulating these foam-like structures can be computationally challenging because it involves processes like drainage, rupture of thin films, and rearrangement of bubbles, each occurring on different length and time scales and lead to the vacuum fluctuation.

They can change shape and size over time, influenced by factors like pressure gradients, gravity, and interactions at bubble junctions. Similarly, in this analogy, the "foam" of space is envisioned as a dynamic system with particles in constant motion and interaction.

3. The Density of the Empty Space

The density of empty space, is also called vacuum energy or vacuum density. From the Planck satellite mission, which measured the cosmic microwave background radiation, the afterglow of the Big Bang, determined the cosmological density to be:

$$\rho = 9.53\times10^{-27}\ \mathrm{kg/m^3}$$

This value is based on a flat ΛCDM (Lambda Cold Dark Matter) model of the universe, which includes dark energy and dark matter [20].

Once we consider the vacuum as a superfluid, we can apply the laws of hydrodynamics to describe the formation of vortices and to provide an useful framework for understanding the formation of mass and the manifestation of the elementary particles.

Relation between Density of the Vacuum and Density of Particle

Mass formation is a concept in theoretical physics proposed to elucidate the origin of particle masses. According to this theory, particles acquire mass through the formation of a "condensate" within the Higgs field. This condensate engenders a non-zero vacuum expectation value of the Higgs field, thereby imparting mass to particles [21] [22].

In the current understanding of the early universe, mere fractions of a second after the Big Bang, the universe underwent a rapid expansion known as inflation. During this epoch, the universe expanded and cooled, leading to the emergence of small "overdensities" and "underdensities". Regions characterized by very low vacuum density manifested negative pressure, precipitating the formation of high-density vortices within the vacuum, representing elementary particles such as electrons and quarks.

Thus, vortex formation in the superfluid vacuum could have acted like gravitational nuclei, attracting energy and causing the formation of denser regions of matter. As the superfluid vacuum flows through these vortices, it experiences a drag force that imparts mass to the particles. Over time, these denser regions evolved into the large-scale structures we observe in the universe today, such as galaxies and clusters of galaxies. The formation of vortices in the superfluid vacuum could therefore have played a crucial role in the formation of these structures.

The mass of elementary particles such as electrons and quarks can be understood as a vortex of superfluid with a certain density, which they pass through in a second. The transition from the initial vacuum state to the high-density quark state during the inflationary epoch is described by a complex set of equations known as the inflationary equations. These equations, based on the principles of general relativity and quantum field theory, describe how the energy density of the universe evolves over time.

The density of a particle is directly related to the pressure and inversely related to the temperature at the moment of its formation. The exact temperature and pressure at the moment of electron formation are not well-defined, as the universe was undergoing rapid expansion and cooling, with conditions varying rapidly.

During the electroweak epoch, the universe was very dense and hot, with temperatures of about 10^{15} K and densities of about 10^{14} g/cm^3. Our understanding of the early universe during this time is still incomplete and is an area of active research in theoretical physics and cosmology.

The value $Te = 6.2 \times 10^{31}$ K is the estimated temperature of the universe at the time of the Planck epoch, the earliest stage of the universe described by current theories of physics.

The relationship between density, temperature, and pressure is described by the ideal gas law, which applies to gases that behave ideally. The ideal gas law is expressed as follows:

$$PV = nRT$$

where:

P is the pressure of the gas,

V is the volume of the gas, n is the number of moles of the gas,

R is the ideal gas constant, which is 1.38 10^{-23} J/˚K,

T is the temperature of the gas.

This equation shows that the pressure of a gas at constant volume and a constant number of moles is directly proportional to its temperature and density. This means that when the temperature or density of a gas increases, the pressure also increases, and vice versa.

Density is defined as mass per unit volume. For an ideal gas, the mass (m) can be expressed in terms of the number of moles (n) and the molar mass

$$m = n \times M$$

Therefore, the density (ρ) can be expressed as:

$$\rho = m/V = n \times M/V$$

Substituting $n = PV/RT$ (from the ideal gas law) into this equation, we get:

$$\rho = M/RT \times P$$

The relationship between the density of the vacuum and the density of a particle depends on the nature of the particle in question and its physical properties. To determine the density of particles, let's use the electron vortex as an example.

Comparing the structure of the electron vortex to that of the Milky Way can be a useful analogy. However, it is crucial to note that the electron vortex is a subatomic phenomenon that occurs on a very small scale, whereas the Milky Way is a galactic structure that occurs on a much larger scale.

The diameter of the Milky Way is estimated to be about 100,000 light-years, with a thickness of about 1000 light-years at its thickest point. This means that the thickness of the vortex is about 100 times smaller than the diameter and 50 times smaller than the radius if we assume that the electron vortex has a similar structure to the Milky Way [23].

The radius of the electron is given $r_e = h/2\pi vm = 5.2895948 \times 10^{-11}$ m, where v is the rotational velocity at the boundaries of the electron vortex, equal to the rotational velocity of the electron in the first orbital of a hydrogen atom, given by $v = e^2/2h\varepsilon_0 = 2.1876913 \times 10^6$ m/s. Where ε_0 is the electric permittivity ($8.854187817... \times 10^{-12}$ F·m^{-1}), e is the electric charge ($1.602176634 \times 10^{-19}$ C) and h is Planck's constant ($6.62607004 \times 10^{-34}$ m^2·kg/s) [24].

However, the radius of the vortex is doubled when we stretch the vortex to measure the area therefore the area would be $A = 2\pi r^2$. The electron structure is similar to the galaxy vortex, and the area of the electron vortex can be calculated by the formula $A = 2\pi r^2$, where the radius is $1.05791896 \times 10^{-10}$ m, giving an area of $A \approx 7.0300696 \times 10^{-20}$ m^2.

Since the thickness of the vortex is 50 times smaller than the radius, its thickness is

$$H = 1.05791896 \times 10^{-10}\ \text{m}/50 = 2.11583792 \times 10^{-12}\ \text{m}.$$

The volume of the electron vortex can be calculated as $V = A \times H$, where A is the area of the vortex and H is its thickness, giving a volume of

$$V \approx 1.487425557672 \times 10^{-31}\ \text{m}^3.$$

Then we can calculate the density of the electron:

density = mass/volume.

The mass of the electron = $9.10938356 \times 10^{-31}$ kg.

Now the density can be calculated as follows:

$$\text{density} \approx \left(9.10938356 \times 10^{-31}\ \text{kg}\right)/\left(1.487425557672 \times 10^{-31}\ \text{m}^3\right)$$

$$\text{density} \approx 6.12915579\ \text{kg}/\text{m}^3$$

Thus, the density of the electron vortex is approximately 6.12915579 kg/m^3.

Therefore, the pressure P during the Big Bang when the electron was formed, with the temperature $T = 10^9$ K, can be calculated according to the equation

$$\rho = RTM \times P$$

$$P = \rho RT/M$$

where

Density of the electron: = 6.12915579kg/m^3,

Molar mass of the electron: $M = 9.10938356 \times 10^{-31}$ kg,

Ideal gas constant: $R = 1.38 \times 10^{-23}$ J/K,

Temperature: $T = 10^9$ K,

P is approximately 9.28×10^{16} Pa.

This calculation provides an insight into the extreme conditions present during the early universe, where the formation of fundamental particles such as electrons took place under incredibly high pressures and temperatures. This understanding is crucial for our comprehension of the universe's evolution and the physical laws governing it.

4. The Formation of Spacetime

Before the Big Bang, there was no spacetime or quantum vacuum state. Spacetime requires both density in motion and particles moving in space, while time requires the movement of particles within space to be measurable. In quantum field theory, the quantum vacuum state is the state with the lowest possible energy, generally containing neither physical particles nor electromagnetic waves. The foam-like Omnium represents a truly stagnant and stable vacuum with very few oscillations, insufficient to create space. However, at the time of the Big Bang, the energy level, pressure, and temperature increased dramatically. This increase caused the Omnium bubbles, which were previously tightly bound together, to undergo phase transitions to less coherent states, forming a false vacuum.

In quantum field theory, a false vacuum [25] describes a vacuum state that is relatively stable but not in the most stable state it could possibly be. This state can endure for an extended period but ultimately has the potential to transition into a more stable state. This transformation is referred to as "false vacuum decay". One prevalent hypothesis for how this decay might occur in our universe is through a process known as "bubble nucleation". This means that if a particular region of the universe were to transition into a more stable vacuum state, a new thermodynamic phase or structure via self-assembly and it would create a localized "bubble" or "bounce" of this new vacuum state [26].

The thermodynamic conditions including temperature, pressure, and density of the system play a significant role. These conditions determine the energy barriers that need to be overcome for nucleation to occur and can affect the size of the nucleation sites.

In the false vacuum decay, the Omniom density undergoes phase transitions that result in nucleation within these structures, eventually leading to the formation of the Planck scale units (PSU), which together form the "Planck plasma". However, when these PSUs begin to align and move coherently, they begin to generate a flow of energy.

This process is stationary and occurs at all scales, from the smallest quantum level to the largest cosmic scales.

In fact, the Planck plasma of the PSU resembles a quark gluon plasma (QGP) in its flow.

QGP has been observed in high-energy collider experiments and is characterized by its extreme coherence [27].

In a QGP, quarks and gluons, the fundamental particles, are no longer tightly bound to each other at extremely high energy densities due to their strong attraction. This leads to a highly organized and coherent liquid-like state. As the coherence decreases mass and strong force appear, such that all the structured matter is supposed to derive from this early-universe cooling process.

The energy density of the Planck plasma undergoes phase transitions, similar to how QGP transitions to a less coherent state as energy decreases. These phase transitions in the Planck plasma lead to a reduction in coherence and, consequently, a decrease in energy. This reduction in coherence and energy plays a fundamental role in forming the structure and the behavior of the universe at various scales.

This stream of Planck plasma undergoes phase transitions, creating boundaries or barriers that lead to the nucleation and condensation of energy, resulting in the formation of photons. This process has been described for the formation of photons during the early phase of the Big Bang in the photon epoch [11].

Similar process described at the atomic level. Spontaneous condensation and quantum vortex formation has been observed at the atomic level in atomic Bose–Einstein condensates [28].

Atomic Bose-Einstein condensates occur at extremely low temperatures. They consist of a collection of atoms, typically bosons, cooled to temperatures near absolute zero (−273.15˚C or 0 Kelvin). At these temperatures, the individual atoms lose their distinct identities, share the same wave function, and merge into a single quantum state. This leads to a high degree of coherence and exhibits the property of superfluidity, meaning they can flow without friction or viscosity.

Similar process was described to describe the collective behavior of electrons by Bohm and Pines where both the classical and quantum mechanical treatments were given [29].

The organized behavior of a high-density electron gas results in what is termed "plasma oscillations" and is treated by use of the collective description. The collective modes of the plasma oscillations are called phonons or plasmons.

The Planck Scale Unit (PSU), as the elementary constituent of spacetime, forms a plasma-like superfluid structure at all scales. Zooming into the quantum scale, this flow is found as Zero-Point Energy (ZPE) fluctuations. Interestingly, these ZPE fluctuations align with ideas proposed by physicist Dirac. He analyzed something called the potential vector Aμ , which ultimately leads to the concept of a velocity associated with an underlying medium.

Dirac noted that light quanta, or photons, seem to vanish when they are in their lowest energy state, which is called the zero state. In other words, they become "invisible" in a sense. Similarly, when Planck scale units (PSUs) are in their zero-point energy state, their energy is so low, below a certain minimum threshold represented as $E_0 < \hbar\omega$, that they are practically imperceptible to us.

This concept ties into the understanding of the quantum vacuum and the structure of spacetime at the smallest scales. The implications of these theories are profound, suggesting that spacetime itself may exhibit properties similar to those of Bose-Einstein condensates, with underlying quantum states that govern the behavior of particles and fields within the universe.

5. The Dynamic Interplay of Vortices in the Creation of Energy and Matter

The currently accepted model for the shape of the fermions including quarks and electrons is that they are a point particle with no size or structure. This model is based on the quantum mechanical description of the electron, which describes it as a fundamental particle with wave-like properties.

However, there are some proposed theoretical models that suggest the possibility of a non-spherical shape of the electron, such as the aspherical model, which proposes a slightly distorted shape characterized by the electric dipole moment [30].

The Higgs theory states that particles are constantly interacting with the Higgs field, which converts the potential energy of the field into individual structures and maintains and renews this interaction. However this theory does not give the mechanism for such interaction. The spin (angular momentum) of an electron suggests that it undergoes internal rotation, which is responsible for its rest mass.

According to quantum mechanics, the vacuum is not really empty, but instead filled with quantum fields that are responsible for the behavior of the particles. The superfluid model of the vacuum states that it behaves like a fluid with no viscosity or flow resistance, which could explain phenomena such as dark energy.

There idea of elementary particles as vortices is not a new concept. There have been several studies and researches in this field.

The spinor model of elementary particles was proposed by mathematician Elie Cartan in the 1920s. This theory states that spinors, mathematical objects that can be thought of as vortex-like structures in spacetime, describe elementary particles. According to this theory, the properties of the particles should be related to the geometric properties of the spacetime in which they exist [31].

The vortex model of elementary particles was proposed in the 1980s by physics Nobel laureate Frank Wilczek. It states that elementary particles such as quarks and electrons are actually vortices in a fluid-like medium called the "aether" According to this theory, the aether is a kind of superfluid with no viscosity, and the vortices in it give rise to the properties we observe in elementary particles [32] [33].

The holon model of elementary particles was proposed by physicist David Bohm in the 1980s. This theory states that elementary particles consist of nested vortex-like structures, which Bohm called "holons". It is assumed that the properties of the particles, such as spin and charge, arise from the behavior of these holons [34] [35].

In the 1990s, a new theory emerged, "topological defect" theory, which also describes particles as vortices in a superfluid medium. This theory was developed to explain the formation of defects in the early universe, such as cosmic strings and monopoles.

More recently, in 2016, a team of physicists at the College of Chicago proposed a new theory that describes elementary particles as knots in the fabric of spacetime. Using mathematical models, they showed that these knots could explain the properties of subatomic particles, including their mass and charge.

Overall, the concept of elementary particles as vortices or knots in a superfluid medium or spacetime is an active area of research in theoretical physics, with many ongoing investigations exploring the underlying nature of these particles.

At the Planck scale, the oscillators within spacetime interact with each other, they give rise to collective behaviours, creating what can be likened to a quantum vortex within the turbulent flow of the spacetime fabric in a specific region of space. This phenomenon is what we perceive as a black hole.

The intricate dynamics of this fluid-like behavior, which we have termed a "Planck Plasma flow", and its connections to both the electromagnetic field and the gravitational fabric of spacetime, have been discussed in prior articles. These articles delve into the details of how these elements interplay and contribute to our understanding of the formation and properties, internal structure of elementary particles such as the electron [7] and to explain the Planck constant origin [36], and fine structure constant [24].

According to this theory, elementary particles such as electrons and quarks are vortices of the vacuum, and the properties of these particles arise from the dynamics of the vortices.

On a larger scale, vortex theory also holds that galaxies and other large-scale structures in the universe are formed by the merging and interaction of cosmic vortices. The theory states that the vortices act as the building blocks of the universe and that the large-scale structure of the universe results from the collective behavior of these vortices [24].

These same vortices are also said to give rise to the fundamental forces of nature, such as the electromagnetic force, the strong nuclear force, and the gravitational force.

The vortex model of the electron assumes that the electron is a circular vortex in superfluid space, with concentric streamlines. This model states that the rotational velocity of the fluid is greatest at the center and decreases with increasing distance from the center until there is no pressure gradient at the boundaries of the vortex, where the flow is laminar and frictionless. The absence of friction makes it impossible to create or destroy the vortex motion. However, for a stable situation to occur, the volume of the negative suction point at the center of the vortex must have sufficient energy to bring virtual photons up to the speed of light (**Figure 1**).

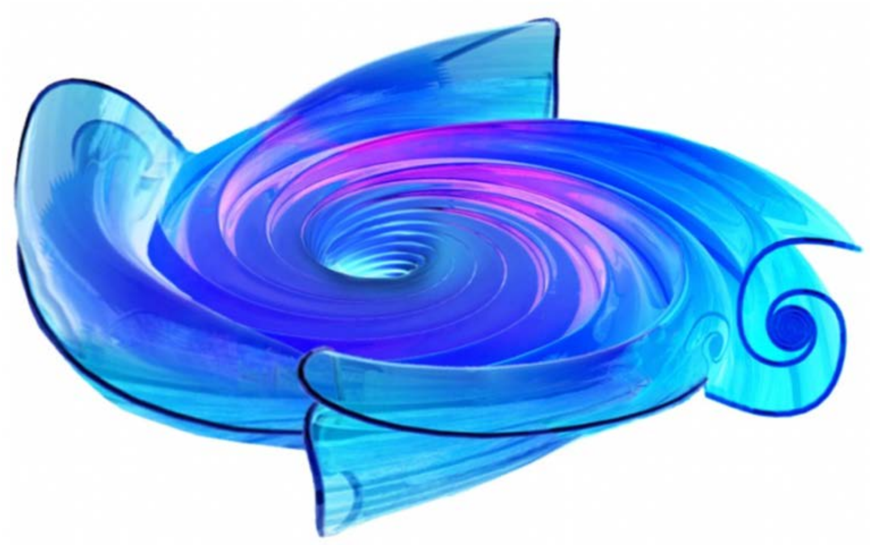

Figure 1. The vortex 3D structure of the electron with concentric spiral four spiral arms that generate force fields that propagate into the surrounding space.

When we apply the principles of hydrodynamics to the vacuum, we can characterize its behavior in terms of flow patterns and the emergence of vortices, which can be correlated with the appearance of elementary particles. This approach holds the promise of providing insights into some of the most profound enigmas in physics, including the origins of mass and the true nature of dark energy. By examining the vacuum as a dynamic medium with its own set of rules, we open up new avenues for understanding the fundamental building blocks of the universe and the forces that govern them.

6. The Origin of Newton's Second Law and the Calculation of Mass from Vortex Shapes

In Newtonian physics, mass is considered an invariant quantity that does not depend on the motion of the object. The equation

$$F = ma$$

States that the force exerted on an object is proportional to its mass and acceleration.

However there is no mechanism that explains the origin of this law.

In hydrodynamics, the rotation of a vortex creates a drag force that attracts the surrounding medium toward the center of the vortex.

This force is directly proportional to the pressure gradient (P) times the area (A), expressed as $F = PA$.

The pressure gradient is related to the density of the vortex (ρ) and the square of the flow speed (v) through the equation $F = 1/2\rho v^2 A$.

When the vortex is stretched, its area A is approximately that of a circle with radius r.

The stretched radius becomes $2r$, so the force on the vortex can be expressed as

$$F = \rho v^2 \pi r^2 .$$

Multiplying right side by the time (t) and then dividing gives

$$F = \rho v t \pi r^2 v / t .$$

Recognizing that v/t is acceleration (a) and ct is the length (L), you can rewrite the equation as:

$$F = \rho L \pi r^2 a .$$

Length times area equals volume (V), and volume times density equals mass (m), leading to the final form of Newton's second law:

$$F = ma .$$

According to Newtonian theory, force (F) divided by acceleration (a) equals mass (m), represented as

$$F/a = m = \rho c t \pi r^2 .$$

This equation relates the mass to the density, rotational speed, radius, and time needed for one rotation cycle of a vortex.

This equation reflects the inertial mass or rest mass of particles like electrons and quarks. It highlights that the mass of a vortex-shaped entity depends entirely on the speed of its rotation. When the speed of rotation is zero, the mass is also zero.

The mass flow rate (m/t), which quantifies the amount of mass passing through a point in a given time interval, can be calculated by multiplying the density (ρ), velocity (c), and the cross-sectional area (A) through which the mass flows. Mathematically, this is expressed as $m/t = \rho cA$.

Therefore, particles such as electrons and quarks can be considered as rotating vacuum fluids. Therefore, their mass is determined based on the mass flow rate. When the rotation (spin) of an electron ceases due to external forces, its mass becomes zero, and it effectively returns to photons.

The derivation demonstrates how the behavior of a vortex and the application of hydrodynamic principles can lead to the fundamental relationship expressed by Newton's second law, connecting force, mass, and acceleration.

This perspective offers an intriguing way to link the concept of mass to the dynamics of rotating structures, which can help us understand the behavior of elementary particles and the role of forces in shaping their properties. It provides an alternative viewpoint on the nature of mass and its relationship to the behavior of physical entities.

7. Relation between Mass and Frequency in Quantum Physics

In classical physics, there is no direct relationship between frequency and rest mass. Frequency typically refers to the number of oscillations or cycles of a wave per unit of time. It is commonly used to describe properties of waves, such as sound waves or electromagnetic waves. Mass, on the other hand, is a property of matter that represents the amount of substance an object contains. Mass is independent of frequency and is not affected by the oscillations or vibrations of waves.

However, in the realm of quantum mechanics and particle physics, there are indirect connections between mass and frequency.

Louis de Broglie proposed that particles, including massive ones like electrons, can exhibit wave-like behavior. The wavelength of these matter waves is inversely proportional to the momentum of the particle, which depends on its mass and velocity. This concept suggests that more massive particles have shorter de Broglie wavelengths, and less massive particles have longer wavelengths.

Einstein's famous equation, $E = mc^2$ implies that energy can have mass, and mass can be converted into energy. In this sense, one could argue that there is an indirect relationship between mass and the frequency of particles, as particles with more energy (and, therefore, more mass) can exhibit higher frequencies or shorter wavelengths in certain situations.

These relationships demonstrate the complex interplay between mass, energy, and wave properties in the quantum realm, but they don't provide a direct relationship between mass and frequency as understood in classical physics.

Through this exploration, we aim to shed light on the origin of the Planck relation,

$$E = hf\ .$$

And its connection to the fundamental nature of particles including their mass.

To relate this to the Planck relation, we must first understand the force driving the movement of a particle as a vortex. Force (F) can be expressed as the product of pressure (P) and area (A), where pressure is related to the fluid velocity (v) within the vortex. Thus, we arrive at:

$$F = P \cdot A\,,$$

where

$P = 1/2\rho v^2$ and,

$A = 2\pi r^2$ because it affects both sides of the vortex. Then

$$F = 1/2\,\rho c^2 \pi r^2 = \rho c^2 \pi r^2 \,.$$

$$F = 1/2\,\rho c^2 t 2\pi r^2 = \rho c^2 t \pi r^2$$

If we multiply the right side by t and divide it by t, we get

$$F = \rho c t \pi r^2 c/t \tag{1}$$

In this equation the $ct\pi r^2$ is length (ct) times area (πr^2) equals volume, and density times volume equals mass, so $m = \rho ct\pi r^2$.

If we substitute f for $1/t$ in Equation (1), we can express

$$F = mcf \,.$$

Assuming that E = force × distance and the distance rotated by an electron vortex in one cycle in vacuum is $2\pi r$, we can express E as

$$E = 2\pi rmcf \,.$$

In previous article, [36] was demonstrated mathematically that Planck constant $h = 2\pi rmc$ which represents a pivotal connection between the angular momentum, mass, and the speed of light of fundamental particles, especially electrons.

The analogy of an electron as a vortex in a fluid vortex with a specific radius "r", the velocity of a fluid element passing a given point remains constant in time. This leads to the concept of circulation or vorticity (Γ), which is quantified as

$$\Gamma = 2\pi rv \,,$$

where "v" represents the velocity of the fluid. This fundamental constant, Γ, characterizes any vortex and remains conserved unless the vortex is destroyed.

Electrons, in this analogy, are likened to tiny vortices with conserved angular momentum (Γm), which is related to the constant circulation or vorticity multiplied by the electron's mass "m".

Thus, the quantity Γm is the angular momentum, and $\Gamma m = 2\pi rvm$ is a constant corresponding to Planck's constant.

In this context, we consider the Compton wavelength, 2.4263102367(11) × 10^{-12} m, to be one rotation of a vortex that has a core circumference of $2\pi r$, the Compton radius is $2.426 \times 10^{-12}/2\pi = 3.861 \times 10^{-13}$ m.

If the radius of the core of the vortex is 3.861×10^{-13} m, $c = 2.99792458 \times 10^{8}$ $\text{m}\cdot\text{s}^{-1}$, and m is the rest mass of an electron $m_o = 9.10938356 \times 10^{-31}$ kg, the angular momentum is $2\pi rcm = 6.627070041 \times 10^{-34}$ $\text{kg}\cdot\text{m}^2\cdot\text{s}^{-1}$, which is within the range of the discrepancies in the experimental values of Planck constant.

Planck's constant expresses the angular momentum of 2π radians, which corresponds to 360˚. The minimum discrete value is equal to Planck's constant reduced by 2π radians, denoted $\hbar$ ("h-bar"). Consequently, this connection resonates with the Planck relation, $E = hf$, where energy (E) is directly related to the frequency (f).

Asking for the mass of the electron vortex, we get

$$m = E/2\pi rcf$$

To calculate the mass (m) of the electron using the equation $m = E/2\pi rcf$,

Given: $E = 8.187 \times 10^{-14}$ joules (energy of the electron),

$r = 3.861 \times 10^{-13}$ meters (radius of the electron),

$c = 2.99792458 \times 10^{8}$ m/s (speed of light),

$f = 1.235 \times 10^{20}$ Hz (frequency of the electron).

Substituting the given values into the equation:

$$\begin{aligned} m &= 8.187\times10^{-14}/2\pi\times3.861\times10^{-13}\times2.99792458\times10^{8}\times1.235\times10^{20} \\ &= 9.10938356\times10^{-31}\ \text{kg} \end{aligned}$$

which matches the known value of the electron's mass.

In essence, these findings emphasize the profound interplay between mass and energy, with the particle's size (radius) and angular velocity playing crucial roles in determining its mass. This perspective offers a unique glimpse into the quantum world, where the fundamental properties of particles are intricately linked and subject to intriguing relationships.

The Compton wavelength (λ) is defined by the equation:

$$\lambda = h/mc$$

This equation relates the Compton wavelength to the mass and speed of light, and it is a fundamental concept in quantum mechanics, describing the wavelength associated with particles such as electrons due to their wave-particle duality.

If $h = 2\pi rmc$, where "r" is the radius of the electron vortex. Then the Compton wavelength can be expressed as:

$$\lambda = 2\pi r$$

This equation reveals that the Compton wavelength is precisely equal to the circumference of the electron vortex. It signifies a profound unity between quantum properties and the dynamic nature of particles.

As we examine the relationship between mass (m), wavelength (λ), and the electron vortex. We recall the equation:

$$m = E/2\pi rcf$$

By substituting

$$f = c/\lambda$$

We unveil a remarkable insight:

$$m = E\lambda/2\pi rc^{2}$$

This equation profoundly indicates that the mass of the particle is directly proportional to its wavelength, specifically in the case of the electron to its Compton wavelength. It is a testament to the intricate relationships that underpin quantum mechanics, emphasizing how the fundamental properties of particles are interconnected and interdependent.

8. Exploration of the Origin of Mass in Special Relativity

Rest mass is a fundamental concept of special relativity that refers to the mass of an object when it is at rest, and it is independent of its velocity. It is a fundamental property of the object that does not change with its velocity or state of motion. The rest mass is also called invariant mass because it remains the same regardless of the reference frame from which it is observed.

Relativistic mass, on the other hand, is a concept in special relativity that refers to the mass of an object moving at a speed close to the speed of light. It is a function of the energy and momentum of the object and increases with velocity. However, in most modern accounts of special relativity, the concept of relativistic mass is no longer used, having been replaced by the concept of rest mass.

Rest mass is a fundamental concept in special relativity, representing the mass of an object when it is at rest. It remains constant regardless of the object's velocity or state of motion, hence termed invariant mass. This property is independent of the reference frame from which it is observed. On the other hand, relativistic mass is a concept in special relativity describing the mass of an object moving at relativistic speeds, close to the speed of light. It is a function of the object's energy and momentum and increases with velocity. However, modern treatments of special relativity tend to avoid using relativistic mass, favouring the concept of rest mass instead. In relativity, mass and energy are interrelated, often referred to as "mass-energy". This is due to Einstein's famous equation

$$E = mc^2 ,$$

where E represents energy, m is rest mass, and c is the speed of light in a vacuum. According to this equation, mass is a measure of the energy content of an object divided by the speed of light squared, expressed as

$$m = E/c^2 .$$

Consequently, as an object's energy increases, so does its mass. This relationship between mass and energy has profound implications for the behavior of objects at high velocities and in strong gravitational fields, forming a cornerstone of modern physics. The origin of mass and its connection to energy have been topics of scientific inquiry for centuries. However, applying the laws of hydrodynamics to the vortex model of elementary particles offers a compelling explanation for both phenomena.

The transverse angular velocity of an electron vortex (ω) is related to the speed of light "c" and the radius "r" of the vortex through the equation

$$\omega = c/r .$$

Additionally, a relationship between frequency (f) and angular velocity (ω) is established as

$$f = \omega/2\pi = c/2\pi r .$$

In this context, frequency (f) is associated with the angular velocity (ω) of the electron vortex.

These equations capture the fundamental attributes of the electron as a vortex, expressing how its properties as a particle are interconnected with its fluid-like behavior.

Energy (E) is a key concept in quantum mechanics, and it is linked to frequency through Planck's constant (h) by the equation

$$E = hf \ .$$

We previously demonstrated that, $h = 2\pi rcm$,

By combining these relationships and applying them to the electron as a vortex, we arrive at an intriguing result:

$$E = hf = h\omega/2\pi = 2\pi rcmc/2\pi r = mc^2 \ ,$$

where "m" is the mass of the electron.

This derivation shows how the concept of an electron as a vortex, with the vortex properties expressed in terms of angular velocity and radius, can be used to derive Einstein's mass-energy equivalence equation. In this unique lens of the vortex analogy, the behavior of the electron as a fluid-like vortex is connected to its mass-energy content. It highlights the fundamental principle that mass and energy are interchangeable in the quantum realm, and it illustrates how seemingly unrelated concepts from fluid dynamics and quantum mechanics can provide insights into the fundamental nature of particles in the universe.

It suggests that the electron's mass, as traditionally understood, is intricately connected to its rotational properties, specifically its angular velocity and radius, within the context of this heuristic model. In this novel interpretation, mass takes on an additional dimension, one that is entwined with the dynamics of rotation.

The transverse angular velocity (ω) of an electron vortex is related to the speed of light (c) and the radius (r) of the vortex through the equation

$$\omega = c/r \ .$$

Furthermore, a relationship between frequency (f) and angular velocity (ω) is established as $f \quad f = \omega/2\pi = c/2\pi r$.

These equations encapsulate the fundamental attributes of the electron as a vortex, illustrating how its particle properties are interconnected with its fluid-like behavior.

Energy (E) is a crucial concept in quantum mechanics, linked to frequency through Planck's constant (h) by the equation $E = hf$.

We have previously demonstrated that $h = 2\pi rcm$.

By combining these relationships and applying them to the electron as a vortex, we arrive at an intriguing result:

$$E = hf = h\omega/2\pi = 2\pi rcmc/2\pi r = mc^2 \ .$$

Here, m is the mass of the electron. This derivation illustrates how the concept of an electron as a vortex, with its properties expressed in terms of angular velocity and radius, can be used to derive Einstein's mass-energy equivalence equation. Within the context of this heuristic model, the behavior of the electron as a fluid-like vortex is connected to its mass-energy content. It underscores the fundamental principle that mass and energy are interchangeable in the quantum realm and demonstrates how seemingly unrelated concepts from fluid dynamics and quantum mechanics can provide insights into the fundamental nature of particles in the universe.

This interpretation suggests that the electron's mass, traditionally understood, is intricately linked to its rotational properties, specifically its angular velocity and radius, within the framework of this heuristic model. In this novel perspective, mass assumes an additional dimension, one entwined with the dynamics of rotation.

If

$$h\omega = 2\pi rcmc/r$$

Then

$$m = h\omega/2\pi c^2$$

This implies that the mass of the electron is directly related to the angular momentum of the electron vortex and inversely proportional to its rotation speed.

This relationship reveals several intriguing aspects: The mass of the electron is intimately connected to its intrinsic angular momentum. Changes in the angular momentum of the electron vortex due to external forces correspondingly alter its mass. Additionally, the mass of the electron is inversely proportional to the square of the speed of light, suggesting that the electron's mass is not a fixed constant but can vary based on its angular momentum and motion properties.

In physics, the theories of special relativity and quantum mechanics traditionally occupy distinct realms of applicability. However, by conceptualizing the electron as a vortex, intriguing parallels between the principles of special relativity and quantum mechanics emerge.

In this model, the electron's angular velocity, associated with its vortex rotation, is linked to both its energy and mass. The frequency associated with its angular velocity corresponds to Planck's quantum theory, while the relationship between its energy and mass recalls Einstein's theory of special relativity. Though unconventional and heuristic, this connection hints at a deeper interplay between these fundamental theories.

It's essential to recognize that this analogy offers an alternative perspective on the mass-energy equivalence of the electron, yet it remains fundamentally heuristic. In reality, the mass of an electron, as defined in modern physics, is considered constant and not directly dependent on its angular momentum or rotation speed. Einstein's equation

$E = mc^2$ illustrates the mass-energy equivalence as a fundamental principle of relativity, with mass typically regarded as an invariant property of particles in quantum mechanics. Nevertheless, the vortex analogy provides an intriguing lens through which to explore the interconnectedness of physical quantities in the quantum realm.

9. Relation between Electric Charge and Mass

In physics, electric charge and mass are intimately linked through the concept of momentum. Momentum, a fundamental quantity describing an object's motion, is defined as the product of its mass and velocity.

Moreover, the principle of conservation of electric charge asserts that the total electric charge within a closed system remains constant over time. This principle aligns closely with the law of conservation of momentum, as any alteration in the charge of a system necessitates a corresponding adjustment in momentum. Thus, the relationship between electric charge and mass constitutes a foundational aspect of the laws governing the behavior of matter and energy across the universe.

The equation governing the electrostatic force between two point charges is as follows:

$$F = \left(kq_1q_2\right)/r^2$$

Here q_1 and q_2 represent the magnitudes of the charges in Coulombs, r denotes the distance between the charges in meters, and k stands for the Coulomb constant. This constant relies on the medium in which the charges are situated and is expressed as:

$$k = 1/\left(4\pi\varepsilon_0\right)$$

The value of ε_0, the dielectric constant of free space, is approximately 8.85 × 10^{-12} F/m.

The electrostatic force between charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them. This equation is fundamental in comprehending the behavior of charged particles and the principles of electromagnetism.

The electric field surrounding a charged object is often depicted by electric field lines or electrostatic lines of force.

In a previous article [10], a new theory concerning electric charge was introduced, based on the vortex model of the electron. This model facilitated an explanation for the origin of bivalency, stability, quantization, and the equality of absolute values of bivalent charges. It also provided a straightforward formulation for calculating electric charge using hydrodynamics, without the need for any constants.

Moreover, it was demonstrated that electric charge can be expressed as the product of Force and Area, which represents the cross product between potential energy and radial distance from the center of the electron vortex, diminished by the vacuum stiffness ε_0. In essence, it is the mass per unit area undergoing acceleration, reduced by the vacuum stiffness.

The strength of these force fields diminishes with the square of the distance from the vortex's center. A visual representation of this model can be illustrated by a **Figure 1** depicting the electron vortex along with its associated electric field lines.

The electron vortex is composed of massless Higgs particles that gain mass as they orbit the vortex's center. The fluid within the irrotational vortex rotates at maximum speed at the center and gradually slows down as it moves away, creating a pressure gradient at the vortex's boundaries, where flow is laminar and frictionless.

The centripetal force exerted by the electron vortex draws the surrounding Higgs field towards its center, generating tension in the surrounding field and an attractive force on other particles.

In the realm of fluid dynamics, a rotating vortex generates a force that pulls surrounding fluid towards its center. The magnitude of this force is directly related to three crucial factors: the density (ρ) of the surrounding medium, the rate of rotation (c) of the vortex, and the total area (A) encompassed by the vortex's spiral arms. This relationship is elegantly captured by the equation:

$$F = \frac{1}{2}\rho c^2 A$$

Here, ρ represents the density of the fluid, c denotes the speed of light, and A symbolizes the combined area of the vortex's four spiral arms.

In the realm of fluid dynamics, when a vortex rotates, it generates a force that draws the surrounding fluid towards its center. The magnitude of this force is directly linked to three crucial factors: the density (ρ) of the surrounding medium, the rate of rotation (c) of the vortex, and the total area (A) encompassed by the vortex's four spiral arms (**Figure 2**).

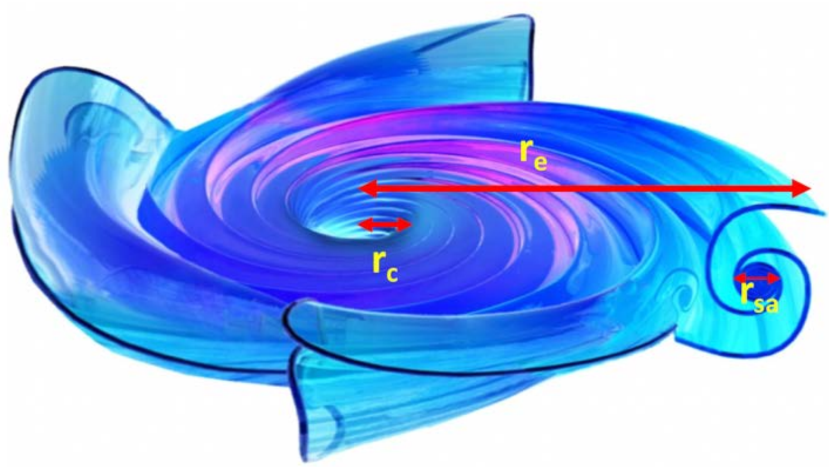

Figure 2. Three different radius in the electron vortex. r_c the core radius of the electron ($r_c = h/2\pi cm = 3.86 \times 10^{-13}$ m where $c = 3 \times 10^8$), r_e the electron vortex radius ($r_e = h/2\pi vm = 5.28 \times 10^{-11}$ m where $v = e^2/2h\varepsilon_0 = 2.18 \times 10^6$ m/s [7]), r_{sa} the radius of spiral arm.

This relationship is elegantly captured by the equation:

$$F = \frac{1}{2}\rho c^2 A$$

In the realm of curved motion, any object following a curved path experiences acceleration, necessitating the presence of a centripetal force directed towards the center of that path's curvature. This force is inversely proportional to the radius r_{sa} of the spiral arm, and can be expressed through the equation:

$$F = \frac{1}{2}\rho c^2 A/r$$

To gain further insight, if we take the right side of this equation, multiply it by the time "t", and then divide it by "t", we arrive at:

$$F = \frac{1}{2}\rho ctAc/rt = \frac{1}{2}\rho Vc/rt$$

Here, "V" represents the volume enclosed by the vortex. This equation underscores the interplay between forces, time, volume, and the radius of curvature in the context of curved motion.

However, the vortex experiences a reduction in the centripetal force due to its interaction with the surrounding vacuum. If we consider the vortex's density as ρ and its rotational velocity as c, we can find the momentum per unit length (Pd) by dividing the momentum ρc by the circumference of the vortex ($\lambda = 2\pi r$). This relationship can be expressed as:

$$Pd = \rho c/\lambda$$

In this way, we can understand that for each unit length, the vortex's momentum is influenced by the factor $\rho c/\lambda$. This leads us to the following expression:

$$F = \frac{1}{2}\rho V \rho c^2/rt\lambda$$

When we consider the circumference of the vortex as $\lambda = 2\pi r$, the equation simplifies to:

$$F = \rho V \rho c^2/4t\pi r^2 .$$

In the realm of hydrodynamics, the term ρc^2 represents the elasticity of the vacuum.

Consequently, we can express the elasticity of the vacuum, denoted as "E", as follows:

$$E = \rho c^2$$

This expression represents the reciprocal of the vacuum's stiffness and aligns with the value of electrical permittivity, signifying that ρc^2 is equivalent to ε^{-1}, establishing an intriguing connection between the vortex dynamics and vacuum properties [16].

The equation $F = \rho V\rho c^2/4t\pi r^2$ can be transformed into the following form:

$$F = \rho V/4\pi r^2 \varepsilon_0 .$$

In the realm of fluid mechanics, when examining the acceleration of the fluid at a specific point, it essentially represents the force acting at that point divided by the density. This quantity is known as the force density (f) [37]. Utilizing this concept, we can express Equation as follows:

$$F/\rho = f = (V/t)\big/\left(4\pi r^2 \varepsilon_0\right)$$

The force density, represented as "f", is a vector field that characterizes the flux density of the hydrostatic force within a fluid. It also serves as the negative gradient of pressure and carries the physical dimension of force per unit volume.

In the realm of fluid dynamics, we often quantify the volume of fluid passing through a given point per unit of time as V/t, representing the volumetric flow rate, often denoted as "q" and measured in units such as m^3/s. This insight allows us to express the force density in terms of q:

$$f = q\big/\left(4\pi r^2 \varepsilon_0\right)$$

What's fascinating is that this formula bears a striking resemblance to the equation used to calculate the force of electric charge. This intriguing parallelism leads us to consider electric charge as the volume flow of the Higgs boson flux from the Higgs field toward the center of the electron vortex. The quantity of charge, expressed in Coulombs (C), can be represented as follows:

$$q = f\,4\pi r^2 \varepsilon_0$$

The Coulomb, in its definition, represents the quantity of charge that passes through the cross-section of an electrical conductor in one second with a current of one ampere. It arises from the interplay between the force and the cross-sectional area defined by the four spiral arms ($4\pi r^2$).

We can utilize the potential energy and the radial distance from the center of the vortex to compute the cross product, subsequently adjusting for the vacuum stiffness ε_0.

By applying Newton's second law ($f = ma$) to equation, we arrive at:

$$q = ma4\pi r^2 \varepsilon_0$$

This equation represents a direct combination of mass (M), length (L), and time (T). When we consider that "a" has units of L/T^2 and "$4\pi r^2$" units of L^2, the final units of charge emerge as $4\pi\varepsilon_0\ ML^3/T^2$.

This remarkable revelation implies that charge represents the quantity of mass (M) traversing a surface of L^2 within the span of time (T) at the speed of light (L/T), all while accommodating the influence of vacuum stiffness ε_0.

This equation shows that electric charge corresponds to a change in the mass of a particle and is an equation of momentum that is conserved. The net charge is always conserved, which is the origin of the law of conservation of charge.

If we use the equation $m = q/a4\pi r^2\varepsilon_0$ and insert $a = c/t$, we get:

$$m = qt\big/4c\pi r^2 \varepsilon_0$$

This equation is a fundamental expression that illustrates the relationship between mass, charge, acceleration, and the permittivity of free space for a charged particle. It is grounded in the law of conservation of momentum and emphasizes that the momentum of a charged particle is equal to its mass times its velocity.

In other words, the mass of a charged particle is directly proportional to its charge and inversely proportional to its acceleration and the square of its radius.

Implications and Insights

The equation $m = qt/4c\pi r^2\varepsilon_0$ indicates that mass is directly proportional to charge and time, and inversely proportional to the product of acceleration, radius squared, and the permittivity of free space.

This relationship suggests that charge can be viewed as a manifestation of mass dynamics within a specific geometric and physical context.

The concept aligns with the law of conservation of momentum, where the momentum of a charged particle is equal to its mass times its velocity.

It emphasizes that the net charge is always conserved, analogous to the conservation of momentum.

By analyzing the units, we see that q (Coulombs) has dimensions of ML^3/T^2, linking mass (M), length (L), and time (T) in a coherent framework.

The term $4\pi r^2\varepsilon_0$ incorporates the geometric and physical properties of the system, integrating the permittivity of free space and the spatial configuration.

The notion that electric charge represents the volume flow of the Higgs boson flux from the Higgs field towards the center of an electron vortex introduces a novel interpretation of charge in terms of fundamental field interactions.

This perspective could potentially bridge gaps between classical electromagnetism and quantum field theory.

Viewing particles as vortices with specific radii and flow characteristics provides a unique way to understand their mass and charge.

The equation suggests that the mass of a charged particle is influenced by its charge, the time scale of its dynamics, and the spatial dimensions of its vortex structure.

10. Discussion

The concept of elementary particles as vortices or knots in a superfluid medium or in spacetime is an active area of research in theoretical physics, with many ongoing investigations exploring the underlying nature of these particles.

In this article, the origin of mass is explained by the formation of a condensate in the Higgs field.

The formation of vortices in the superfluid vacuum may have played a crucial role in the formation of structures in the universe, as the denser regions would have evolved into the large-scale structures we observe today. It is worth mentioning that the vacuum has a density, but no mass, because it stood still up to the time of the big bang.

According to the present understanding of the Standard Model of particle physics, the particles have originated from fluctuations in quantum fields which exist everywhere in the space, among them also the Higgs field.

These fluctuations can lead to the formation of particle-antiparticle pairs, which can then interact to produce the particles we observe. In the standard model of particle physics, the fundamental quantum fields include the electromagnetic field, the weak force field, the strong force field and the Higgs field. The Higgs field plays a crucial role in this process by imparting mass to the particles through interactions with the Higgs boson.

In this article, however, we refer to the vacuum that existed before the appearance of all known forces or particles, including the Higgs boson. This vacuum had a density, but since there was no motion, there was no energy or virtual particles in this state.

Shortly after the Big Bang, the temperature of the universe was incredibly high, leading to a rapid expansion known as inflation. A low pressure was created in places with very low vacuum density, high gravitation force which led to the formation of high density vortices structures such as electrons and quarks.

Each elementary particle has a mass, a density and a volume. In addition, they possess a spin, which means that they have an internal rotation.

The density of a particle can be determined by dividing the mass of a cubic meter of vacuum by the volume of the particle, according to the equation

$$\text{Density}_{\text{particle}} = \text{mass}_{\text{vac}}/\text{volume}_{\text{particle}}$$

Newton's second law was derived from hydrodynamics of the vortex, where the rotation of a vortex produces a drag force that pulls the fluid toward the center of the vortex.

The mass of a particle can be determined by calculating the mass of the particle vortex, if one knows the radius and the minimal time needed to complete one rotation cycle.

According to the equation

$$m = \rho ct\pi r^2 .$$

The concepts of rest mass and relativistic mass in special relativity and their relationship to energy are discussed.

The Einstein equation $E = mc^2$ derived calculating the transverse angular velocity of the vortex according to the equation

$$E = h\omega/2\pi = 2\pi rcmc/2\pi r = mc^2 .$$

The mass can be expressed as

$$m = h\omega c^2/2\pi$$

According to the electron vortex model the electric charge is the accelerated mass per area reduced by the stiffness of the vacuum. Thus the mass of a charged particle is directly proportional to its charge and inversely proportional to its acceleration and the square of its radius according to the equation

$$m = q/4a\pi r^2\varepsilon_0$$

This equation is a fundamental expression that shows the relationship between mass, charge, acceleration, and the permittivity of free space for a charged particle.

The law of conservation of momentum is the basis for this equation. It emphasizes that the momentum of a charged particle is conserved.

The vortex model of elementary particles, coupled with the laws of hydrodynamics, provides an elegant explanation for the origin of mass and the relationship between mass and energy. The relationship between mass and energy has profound implications for the behavior of objects at high velocities and strong gravitational fields.

The electron is treated as a vortex with conserved angular momentum related to circulation or vorticity.

The force density of a vacuum superfluid is used to derive equations relating charge, mass, acceleration, and the permittivity of free space for a charged particle. Force density is the negative gradient of pressure and has the physical dimension of force per unit volume.

11. In Summary

A novel theory regarding the formation of mass and matter is presented in this article. Specifically, we refer to the vacuum state that existed before the appearance of all known forces or particles, including the Higgs boson. This pre-existing vacuum had a density, but due to the absence of motion, it contained no energy or virtual particles.

The vortex model of elementary particles, when coupled with the principles of hydrodynamics, offers an elegant explanation for the origin of mass and the relationship between mass and energy. This model suggests that the concept of vortices and the circulation of fluid elements within particles can provide new insights into the fundamental nature of particles.

By applying the laws of hydrodynamics to the behavior of particles, the vortex model suggests that the mass of a particle is a result of the dynamic properties of these vortices. This model not only aligns with known physical laws but also opens up new avenues for understanding the intricate relationship between mass and energy in the universe.

This innovative approach challenges traditional views and provides a fresh perspective on how mass and matter came into existence. It highlights the importance of considering fluid dynamics and vortex behavior in the study of fundamental particles, potentially leading to ground breaking discoveries in the field of particle physics.

Summary of Findings

Dark Energy and Quiescent Superfluid Vacuum: The ultimate reality of the universe before the Big Bang was a superfluid vacuum with a density of approximately 9.5×10^{-27}. This state from which everything else emerged.

Big Bang Dynamics: The infinitely high temperature of the Big Bang led to universal expansion, pressure, and density changes, with under-condensation and over-condensation of the vacuum, ensuring that the final universal density remained constant.

Elementary Particles as Vortices: Quarks and electrons are vortices of over-condensation of the vacuum.

Properties of Elementary Particle Vortices: These vortices have density, mass, radius, area, circumference, volume, rotational velocity, minimal time, frequency, and flow rate.

Hydrodynamic Laws: The behavior and properties of elementary particles can be described by the laws of hydrodynamics.

Force in Vortex: The force that rotates the vortex is directly proportional to the density of the vortex, times the square of its rotation speed, and its area: $F = \rho c^2 \pi r^2$.

Density Relationship: The density of the particle vortex relates to the vacuum density:

$\rho_{\text{vor}} = \text{mass}_{\text{vac}} / \text{volume}_{\text{vor}} = \rho_{\text{vac}} c^2 \pi r^2 / V_{\text{vor}} a$ (V = volume of the vortex, a us the acceleration of the vacuum).

Mass and Dimensions: The mass of the particle vortex is directly proportional to its density, area, and height: $m = \rho \pi r^2 H$.

Density Calculation: The density of the electron is directly proportional to the vortex mass and inversely proportional to its square radius and height: $\rho = m/\pi r^2 H$.

Frequency of Vortex: The frequency of the particle vortex is directly proportional to its rotational speed and inversely proportional to its circumference: $f = c/2\pi r$.

Mass and Energy: The mass of the electron vortex is directly proportional to its energy and inversely proportional to its radius and frequency: $m = E/2\pi rcf$.

Electric Charge: The electric charge q of a particle vortex is equal to the volume of superfluid omnium flowing per unit time: V/t.

Charge and Mass: The mass of the particle vortex is proportional to its electric charge and inversely proportional to the square radius and frequency of the spiral arm: $m = q/4c\pi r^2 \varepsilon_0 f$.

12. Conclusions

One of the most important implications of vortex theory is its potential to unify the behavior of particles at the quantum level with that of large-scale structures in the universe. This theory suggests a fundamental connection between these seemingly disparate phenomena, positing that the behavior of the universe as a whole can be understood in terms of the vortices that pervade it.

The ongoing search for a complete understanding of the nature and origin of mass will likely require the development of new theories and experimental techniques. Nonetheless, using the electron as a vortex analogy serves as a valuable thought experiment. This analogy highlights the interconnectedness of physical phenomena in the quantum realm and provides an intuitive bridge to the mass-energy equivalence principle. It reminds us that the subatomic world is a realm of fascinating complexity, where different perspectives can shed light on the enigmatic behaviors of particles. In the quest to understand the universe at its most fundamental level, such analogies continue to inspire new avenues of exploration and discovery.

Our journey through quantum mysteries has uncovered a web of relationships between mass, wavelength, and the dynamic behavior of particles as vortices. De Broglie's insights into wave-particle duality set the stage for our exploration, while the Compton wavelength connected the wavelength to the particle's mass and the speed of light. The revelation that the Compton wavelength precisely matches the circumference of the electron vortex underscores the profound unity of quantum properties and particle dynamics. Furthermore, the direct proportionality between mass and wavelength, exemplified by the electron's Compton wavelength, highlights the intricate fabric of the quantum world.

In conclusion, our journey serves as a testament to the ceaseless quest to understand the quantum realm, where fundamental properties are not isolated but intricately linked. This intricate web weaves a tapestry of knowledge that continues to unravel the mysteries of the subatomic universe.

Conflicts of Interest

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

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