The Nuclear Quantum Gravity + Superconducting Field Theory (ToE)

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Abstract

A Theory of Everything (ToE) is any model of physics that explains and connects all fundamental interactions (strong force, electromagnetism, weak force, and gravity) into a single force. Here, we show a path that integrates chemistry and astrophysics to unify these forces, explaining gravity, dark matter, and dark energy without requiring additional dimensions or external forces.

The first part unifies the strong nuclear force with the gravitational force in a mathematical way; the strong nuclear force can deform the quantum vacuum.

The second part unifies the strong nuclear force with the quantum vacuum in a hypothetical structure; the quantum vacuum is treated as a system with properties related to the different types of particles' motion.

Keywords: Unification theory, Strong nuclear force, Quantum vacuum, Quantum gravity, Dark matter, Dark energy, QCD.

Contents

1. Introduction

This paper describes how the nuclear force can **compress** the quantum vacuum **generating the gravitational force** with a strength equivalent to that described by Newton's laws in classical physics. The exact point at which quantum dynamics transforms into classical physics based on 2 basic concepts:

- The **strong nuclear force**, which has always been a controversial force, is responsible for holding the atomic nucleus together and at present the mechanisms that govern its internal dynamics remain largely unknown. It has been underestimated due to its extremely small field of action in the search for a possible interaction with the gravitational force, but if we turn our attention to its internal interaction instead of its external one, we can create a basic piece for a somewhat more complex and extremely important model. The study of the strong interaction was responsible for the origin of string theory with the S-matrix, a physical system in which the point-like particles are replaced by one-dimensional objects called strings, although it later drifted towards any type of vibration in space.

- The **quantum vacuum** or aether, which has been ignored to a certain extent, can be responsible for the most important interactions over long distances, perceived as a metamaterial medium capable of transmitting light in a vacuum as many experiments have tried to explain from Lorentz to Michelson-Morley, or as an energetic field as demonstrated by the Casimir effect as well as the Lamb shift. Its topological structure has been another source of discussion, developing branches like twistor theory, spinors, or knots in an attempt to explain the geometric and spin-dependent properties of particle interactions, being the possible origin of all vibrational states of particles.

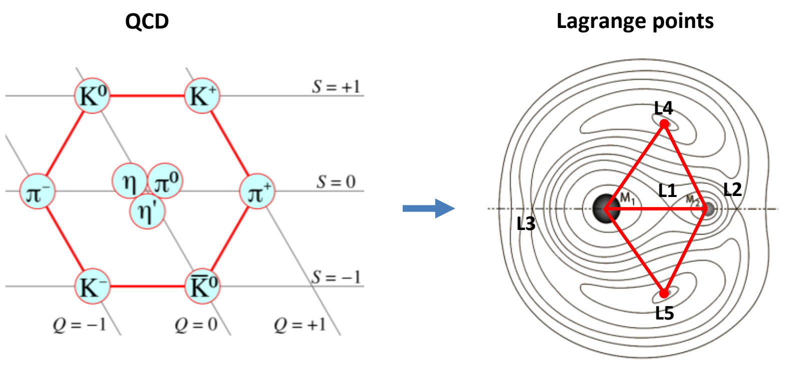


Fig. 1: From quantum dynamics to general relativity.

In contrast to theories based on external fields this physics theory employs only 3 spatial dimensions and time, being compatible with the Standard Model: the strong nuclear force behaving as a two-dimensional force with a mathematically described internal force, and the quantum vacuum capable of sustaining different types of motion in atomic and subatomic particles through a hypothetical multistable system.

2. Background

2.1 The Strong Nuclear Force

The atomic nucleus is the fundamental constituent of matter located at the center of an atom, composed of protons and neutrons, each formed from 3 quarks. These **quarks remain bound together due to the strong nuclear force** (the strongest of the fundamental forces) which acts over a range not greater than 10^{-15} meters. It has been determined that more than 99% of the proton mass resides in the atomic nucleus with a very small contribution from the electron cloud.

Gluons act as the exchange particles for the strong force between quarks, preventing their separation through a constant attractive force, theoretically reaching values on the order of **10.000 N (≈ 1.000 Kg)**.

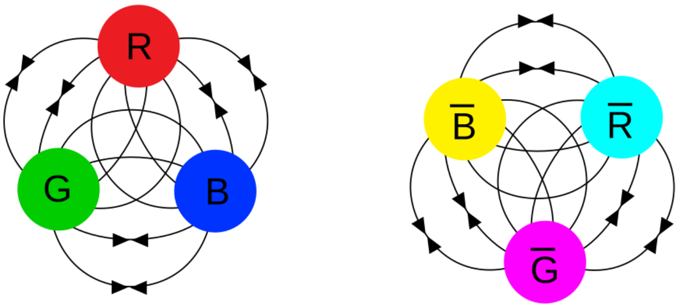


Fig. 2: Color charge transitions (QCD).

Quantum Chromodynamics (QCD) is the theory that describes the strong force, where a quark's color charge can take one of three states: red, green, or blue. An antiquark can take one of three anticolors, referred to as antired, antigreen, or antiblue. Gluons are a combination of a color and an anticolor state, such as red and antigreen, which constitute their color charge. The term 'color charge' in quarks and gluons is not related to the everyday meanings of color and electric charge; rather, it denotes an internal quantum degree of freedom.

Recent studies in lattice QCD have found that the force distributions within the proton depend on the internal spatial positions of its constituent quarks [1].

2.2 The Quantum vacuum

Two inherent qualities of the quantum vacuum may be distinguished:

- A perfect superconductor for particles. The distance to the most distant galaxy detected by human beings exceeds 30 billion light years, which means there are photons capable of traveling such vast distances without any reduction in speed, modifying only their wavelength. Like light, an object can move into space for a practically unlimited period as long as it doesn't find a force to stop it, so we can determine that the vacuum possesses a resistance equivalent to 0.
- An intrinsic tension. For the propagation of waves, a strongly coupled structure is needed. Gravitational waves could behave like ocean waves, which are similar to an uptight net, these tensions can be decomposed as a unitary set of points tenser than any known structure and subjected to extreme repulsive forces that enable the universe's expansion.

These qualities would describe the quantum vacuum as a **superfluid** with zero viscosity and any loss of kinetic energy, having a practically infinite capacity to conduct particles and an extremely high density. It is worth nothing that the Earth moves through the universe at an estimated velocity of approximately 600 km/s.

Centre for the Subatomic Structure of Matter

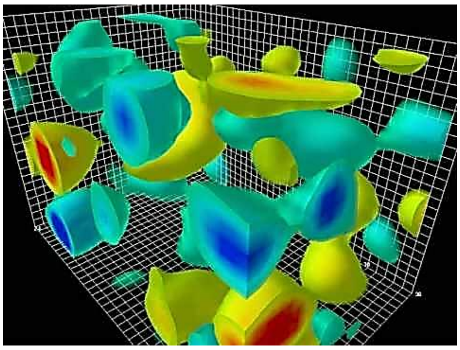


Fig. 3: Vacuum fluctuations (QCD).

This real picture illustrates the three-dimensional structure of gluon-field configurations, describing vacuum fluctuations in which quarks continuously appear and disappear. The volume of the box is 2,4 x 2,4 x 3,6 fm, inducing chromoelectric and chromomagnetic fields in its lowest energy state. The frame rate in this real example is billions of billions of frames per second (FPS).

3. Nuclear Quantum Gravity (Strong Force unification)

3.1 Fundamentals

This new framework describes matter contracting the quantum vacuum, while the quantum vacuum simultaneously enables the transport of matter without friction. Quarks bind together and interact through the strong nuclear force, which holds matter together and allows it to travel through space as if it were a superconductor).

As an example, I've chosen the smallest and most abundant chemical element in the universe, the hydrogen atom, with an estimated **mass of 1,673 × 10^{-27} kg and a theoretical strength of 10.000 Newtons**, which contains a single electron and a single nucleus. This nucleus consists of one proton the basic constituent of matter, in which the strong nuclear force acts. The proton is itself composed of two up quarks and one down quark bound by gluon interactions (all matter is ultimately formed from sets of 3-quark structures).

Based on these data about the **hydrogen nucleus**, this study calculates a possible **average interaction** occurring during its internal transformations, which may generate a force that tends to contract the vacuum. To illustrate this concept, we can consider an elastic band (representing the proton's strong force with an approximate length of 8,58 x 10^{-15} meters) compressing two V-shaped sticks at their broadest end; if the sticks are sufficiently smooth and rigid, the elastic band will slide toward the narrower side. The greater the number of elastic bands, the greater the force exerted on the sticks to join them; likewise, the greater the amount of matter concentrated at the narrow end, the stronger the resulting attraction at the top.

This study involves unknown limits, such as infinite conduction or tensions never before observed.

Proton (hydrogen atom nucleus) $m_p = 1,673 \times 10^{-27}$ kg | **The nuclear strength contracts vacuum** $F_p = 10.000$ N ≈ 1.000 Kg | **Contraction generates an acceleration** $g = 9,8\ m/s^2$

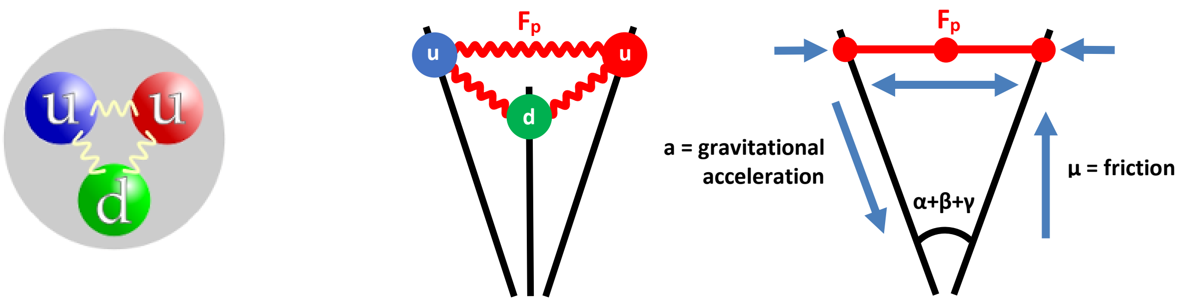


Fig. 4: Mathematical reduction of the forces involved to 2 dimensions.

3.2 Strong force contraction

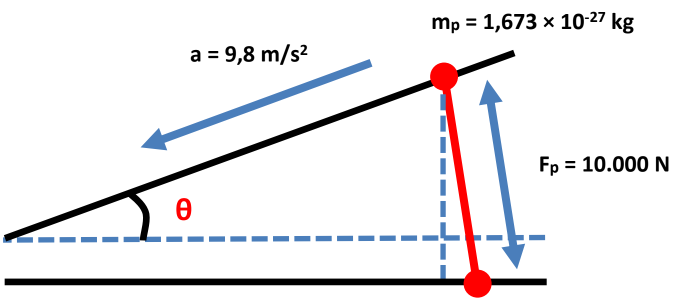
The calculation involves determining the **angle** at a specific point on the Earth's surface that produces its gravitational acceleration, representing the corresponding deformation of space. This is done by applying the equations for inclined planes based on Newton's second law [9], using the following values:

- The proton mass has an estimated value of 1,673 × 10^{-27} kg (m_p).
- The proton strong force corresponds to an equivalent contraction force, having an estimated strength of 10.000 N (F_p).
- The gravitational acceleration at the Earth's surface corresponds to the acceleration component acting down the inclined plane, 9,8 m/s^2 (a).
- The friction is 0, not applicable (µ).

These variables are the average values from quantum dynamic interactions collected through classical physics.

** ***Figures 4 and 5*** *are the most important in this document and must be understood before proceeding. Figure 5 presents the calculations with the parameters from Figure 4, positioned horizontally to simplify the problem.*

The strong force (F_p) creates a contraction and an attraction (a = g)



**** Fig. 5: Equivalence of forces in the inclined plane.**

1. Variables set considering a proton.

   $m_p = 1{,}673 \times 10^{-27}\ kg$

   $a = 9{,}8\ m/s^2$

   $F_p = 10.000\ N$

2. Apply the laws of inclined planes to the previous variables.

   $$m \times g \times \sin(\theta) = m_p \times a \qquad (1.1)$$

   $F_p = m \times g = 10.000\ N$

   $F_1 = m_p \times a = 1{,}673 \times 10^{-27} \times 9{,}8 = 1{,}6395 \times 10^{-26}\ N$

   $F_p \times \sin(\theta) = F_1$

   $\theta = \arcsin(F_1 / F_p) = \arcsin(1{,}6395 \times 10^{-30})$

3. Planet Earth's angle is shared by 3 quarks, producing an acceleration of 9,8 m/s². This deviation occurs at the proton scale, which has an estimated margin of error of about 2%.

   $$\boldsymbol{\theta = 9{,}393 \times 10^{-29}\ ^\circ} \qquad (1.2)$$

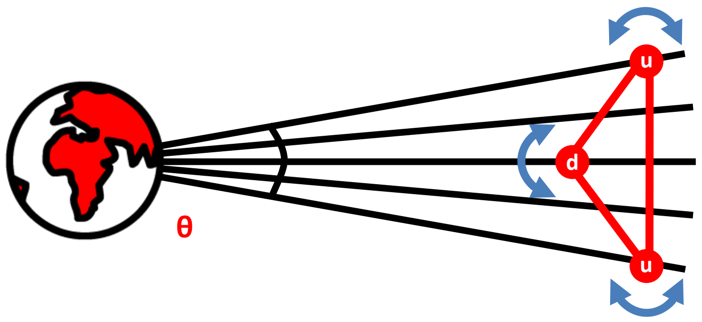


Fig. 6: Quarks scope.

Mass is defined as a quantity representing the amount of matter contained in a particle or an object. Its calculation has many variations, such as weight / acceleration (due to gravity); force / acceleration; or density × volume, all of which are associated with the framework used in this study.

This model would correspond to what is known as quantum gravity (QG), which aims to describe gravity according to the principles of quantum mechanics, erasing gravity as one of the fundamental interactions of nature and turning the strong force into its generator, acting upon each nucleon (protons and neutrons) in isolation.

3.3 Quantum vacuum density

Dark matter could have its origin due **to variations in the quantum vacuum density (our superconductor)**. An increase in the spatial extension between quarks could turn mass (m_p) into tension energy (F_p), causing certain regions in the universe to have lower or higher accelerations due to this effect; this suggests that dark matter may not exist as a distinct form of matter but rather as a manifestation of these vacuum fluctuations, which is estimated for approximately 27% of the mass in the observable universe.

The most significant related discovery might be the **asymptotic freedom**, a property of quantum chromodynamics (QCD) in which interactions between quarks become weaker as the energy scale increases and the corresponding length scale decreases. The fact that couplings depend on the momentum (or length) scale is the central idea behind the renormalization group , which ensures finite physical quantities in quantum field theory.

Separation between quarks modifies the force exerted

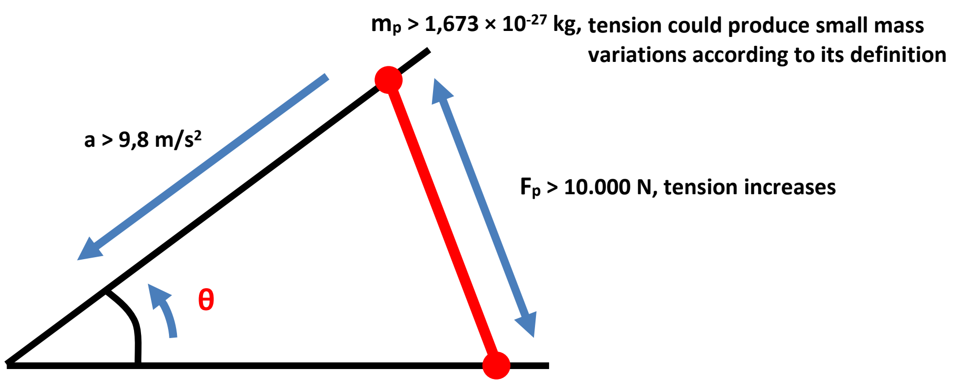


Fig. 7: Quarks behave like an elastic band.

The precise relationship between the density of the quantum vacuum and the strong nuclear force remains uncertain, so this is just an estimation, but it's expected that more concentration of vacuum energy may cause quark expansion, modifying all the relations. For example, we can introduce different modifications to test this hypothesis:

1. Calculate the relation between the angle and the acceleration.

$$F_p \times \sin(\theta) = F_1 \quad (2.1)$$

$$F_1 = m_p \times a = 1{,}673 \times 10^{-27} \times a$$

$$\theta = \arcsin(F_1 / F_p) = \arcsin(1{,}673 \times 10^{-31} \times a)$$

2. A bigger angle generates more acceleration.

$$\boldsymbol{a \approx (\theta / 1{,}673 \times 10^{-31})\ m/s^2} \quad (2.2)$$

Another example can be considered by applying a smaller force in the nucleus to test the system's response:

1. Set the nuclear force to $F_p = 7.000N$

$$a = F_p \times \sin(\theta) / m_p \quad (3.1)$$

$$a = 7.000 \times \sin(1{,}6395 \times 10^{-30}) / 1{,}673 \times 10^{-27}$$

$$\boldsymbol{a = 6{,}85\ m/s^2}$$

Despite the historical rivalry between Newton and Hooke, stemming from Hooke's accusation of plagiarism against Newton, Hooke's law [10] (the elasticity constant) provides an effective way to describe this behavior at **a single point in space**. The strong force exhibits a positive correlation between its magnitude and the resulting acceleration; increasing F_p or m_p implies a greater acceleration, analogous to the **behavior of a spring** that produces spatially varying stresses. The force (F_p) is proportional to the displacement required to extend or compress the 'spring'; this tensor is responsible for generating the **metric tensor ($g_{\mu\nu}$)** which defines distances and angles, as in the case of the **Ricci curvature ($R_{\mu\nu}$)**.

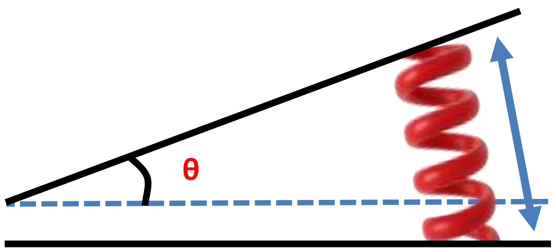


Fig. 8: The strong interaction as the field tensor generator.

But in reality, space does not deform proportionally, creating more acceleration in regions with higher mass concentration and thus behaving analogously to an elastic medium. This behavior can be quantified by the elastic modulus (or Young's modulus), which represents the factor of proportionality in Hooke's law in non-linear systems. The Young's modulus (E) [8] depends on the stress exerted by matter (σ) and the strain (Ɛ) at each point in the deformation field.

$$E = \Delta\sigma / \Delta\varepsilon$$

The rate of change of the force with respect to the angle (θ) increases (Δ) faster than the strong force (F_p) with respect to mass (m_p); the greater the distance, the weaker the force.

$$\Delta F\theta > \Delta F_p / \Delta m_p \quad (4.1)$$

The contraction in the atomic nucleus and its relationship to the vacuum density can exert a force over long distances.

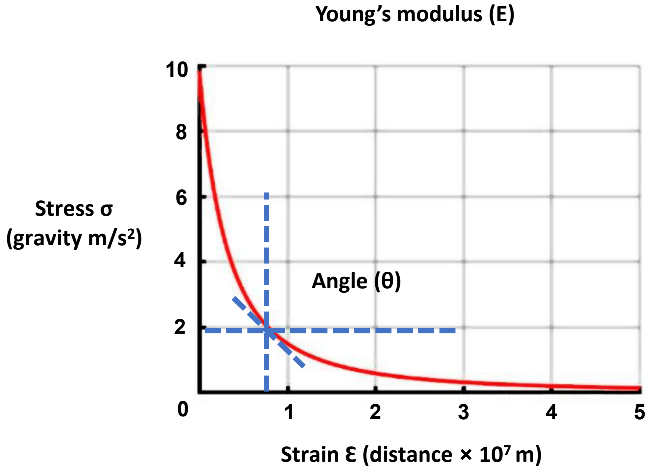


Fig. 9: Gravitational field around Earth.

The relation between the strong force and the quantum vacuum modifies the space density since it induces mutual convergence through electromagnetic extraction and dispersion; therefore, we can refer to the existence of a bulk modulus (K), which depends on pressure (p) and volume (V) variations.

$$K = -V\,(\Delta p / \Delta V)$$

We only know this relation through calculations based on Earth's conditions, but it must be associated with actual hypothesis such as General Relativity (GR) and the Einstein Field Equations (EFE), where matter bends space through a mechanism of still unknown origin, determining the geometry of space depending on the distribution of matter across complex energy-density fields. Also, we can find other possible connections, like the Modified Newtonian Dynamics (MOND) hypothesis [4], which proposes a modification of Newton's law of universal gravitation to account for the observed dynamics of galaxies having several observational evidences, although it becomes less accurate at large scales.

$$\underbrace{R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu}}_{\text{Matter tells space how to bend}} = \underbrace{\frac{8\pi G}{c^4}T_{\mu\nu}}_{\text{Space tells matter how to move}} \qquad \text{Einstein Field Equations (EFE)} \qquad (5.1)$$

Other properties, such as volume viscosity, (also known as volume viscosity), may be considered to describe the dissipative behavior of the medium.

3.4 Fundamental interactions (1)

At this stage, this represents the new classification of the fundamental interactions:

- The strong force and gravity have been unified.
- Electromagnetism and the weak force are actually unified by the electroweak interaction.
- The quantum vacuum is considered a new fundamental interaction because of its strength and the fact that it isn't reducible to more basic forces.

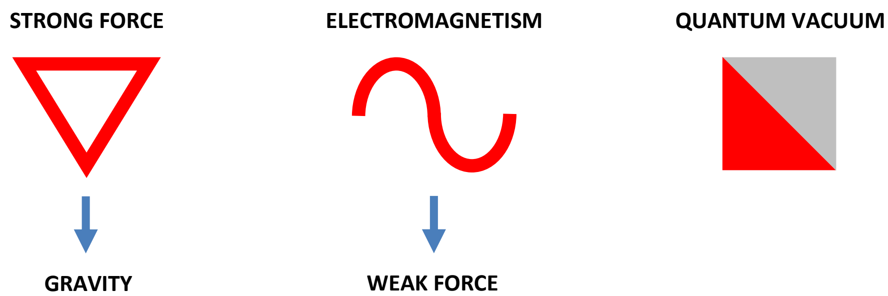


Fig. 10: Fundamental interactions.

However, this diagram could be improved for greater clarity.

4. Superconducting Field Theory (Theory of Everything)

4.1 Quantum vacuum structure

We require a quantum vacuum structure that allows us to unify the different types of fields and their behaviors, being at this point the most important aspects: the constant motion of **matter**, the movement of **subatomic particles,** and the generation of **electromagnetic fields**. One solution would be a metastable system with different balances; the topological model consists of polarized triplets, rotated in a static balance (a symmetric group), differentiated in the 3 spatial axes, with each element in continuous mutual **repulsion**.

- Matter is composed of protons and neutrons (nucleons), which constitute each element of the periodic table; at the same time, each nucleon is composed of 3 quarks. The only way to maintain the velocity of matter stable and not be accelerated to the speed of light is through an asymmetric vacuum, in this way the repulsive and attractive forces of each quark triplet (ψ) are balanced by the 3 spatial directions in which the vacuum triplets are arranged (quarks triplets against vacuum triplets). The average sum of all vector forces (V_F) in each spatial direction is 0, for this reason, matter is not accelerated to the speed of light, the asymmetrical multistability of the vacuum prevents such acceleration.

$$\psi = \begin{pmatrix} \psi_x \\ \psi_y \\ \psi_z \end{pmatrix} \qquad \overline{\psi} = \begin{pmatrix} \vec{\psi}_x \\ \vec{\psi}_y \\ \vec{\psi}_z \end{pmatrix} \qquad (6.1)$$

$$\bar{V}_{FX} + \bar{V}_{FY} + \bar{V}_{FZ} = \bar{V}_F\ net = 0$$

This asymmetry is the cause of quantum chromodynamics (QCD) [5] colors and anti-colors (3 types of each) and their transformations, where the nucleon structure doesn't collapse inward due to the counteracting outward vacuum forces, being nucleons the only subatomic structures bigger than each individual frame capable of surviving it. Moreover, the different types or flavors of neutrinos (electron, muon, and tau) can be studied as a dynamical system involving triplet interactions, analogous to the interaction between matter and the vacuum.

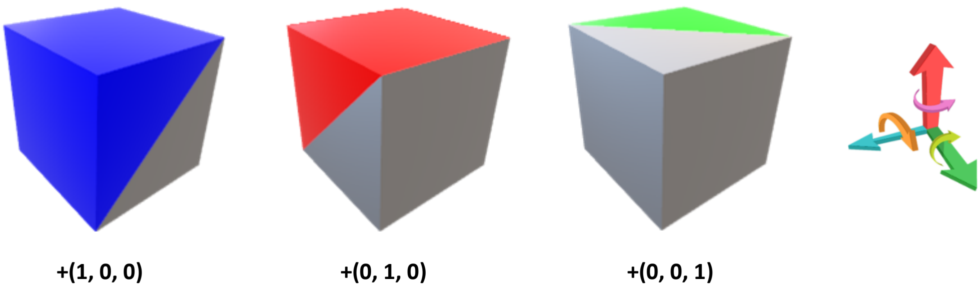


Fig. 11: Motion of matter in equilibrium (x, y, z).

- Its ±½ polarization shapes fermions, having an internal force trying to expand with a spherical distribution as is theorized for U(1) gauge, so particles smaller than this polarized frame can be easily dispersed in all directions.

$$|\uparrow\rangle \equiv \left|+\tfrac{1}{2}\right\rangle \quad |\downarrow\rangle \equiv \left|-\tfrac{1}{2}\right\rangle \qquad (6.2)$$

  Both the vacuum permeability and permittivity (associated with the density of an electric field defined by Maxwell [7]) are derived from the magnetization and polarization properties of the quantum vacuum to create virtual electrons, having as their greatest quality to emit or absorb energy. The collective alignment of each magnetic moment creates magnetic domains, where temperature and atomic structure play crucial roles.

  All the elements in the periodic table have an atomic number equal to the number of their electrons, while their nucleon number determines their mass. Consequently, nucleons may be capable of exchanging this energy as electromagnetic energy with their polarized vacuum surroundings. The strength of the electromagnetic interaction between elementary charged particles is known as the **fine-structure constant**, which governs the electromagnetic interactions responsible for the formation of chemical bonds such as the hydrogen bond (under normal conditions, it is impossible for a proton not to possess an electron). These electromagnetic attractions can affect the gravitational force, though only in a residual manner.

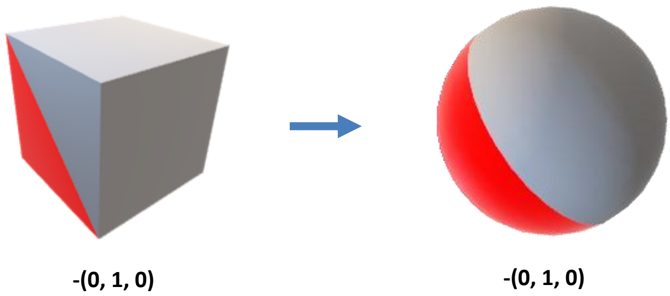


Fig. 12: Electromagnetic field extraction (± 1/2).

- Light has its own inertia through its momentum; it travels at approximately 300.000 kilometers per second, but it slows down to about 225.000 kilometers per second when passing through water (it depends on the electromagnetic properties of the medium through which it propagates), recovering its original speed when leaving it.

  Subatomic particles (photons or neutrinos) are smaller than this fundamental frame, so they can be transported by the vacuum; their infinite amount of accumulated inertia comes from the spin speed (S_F) of this energetic vacuum, where quarks are trying to be accelerated too, but its inherent stability prevents such acceleration.

$$\bar{S}_{F1} = c \qquad (6.3)$$

These fundamental frames may be regarded as the smallest discrete units of time, where other phenomena can be examined, such as the photon generation through a monopole interaction.

Fig. 13: Subatomic particles transportation (c).

The particles' escape angles are needed to shape the nested spin networks, taking into account the different positions of all containers in space (two distinct positions along each axis and its conjugates), at the same time, their internal forces are related to the potential walls found in **quantum tunneling**. The set of possible positions along the coordinate axis according to their unit vectors (U) are:

$$U_X = \{+(1, 0, 0), +(-1, 0, 0), -(1, 0, 0), -(-1, 0, 0)\} \qquad (7.1)$$

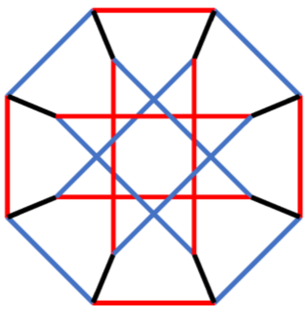
$$U_Y = \{+(0, 1, 0), +(0, -1, 0), -(0, 1, 0), -(0, -1, 0)\}$$

$$U_Z = \{+(0, 0, 1), +(0, 0, -1), -(0, 0, 1), -(0, 0, -1)\}$$

I'll name each individual cube **QDS** (Quantum Decimal Spinor), because its main quantum characteristic consists in being composed of 2 prisms with a structure of 5 + 5 faces (pentahedrons) and a chirality based on their spins.

These structures can help to build the internal symmetries of the Standard Model, **SU(3) × SU(2) × U(1)**, by isolating each individual symmetry. The Gell-Mann matrices, a representation of the **SU(3)** group, in which quarks possess color quantum numbers and form the fundamental triplets; the Pauli matrices, a representation of the **SU(2)** group, which reproduce the electron's spin; and the simplest internal symmetry group, **U(1)**.

This solution can accommodate the principal types of motion and represents, for the first time, a theorized **nonlinear structure** designed to address the calculation adjustments required in **renormalization**. It seeks to resolve anomalies associated with the non-intuitive behavior of quantum systems, particularly in operations within four-dimensional space. These operations involve the construction of hypercubic geometries (**tesseracts**) representing spatial states, where matrices are employed to describe linear transformations between vector spaces. The resulting framework extends from the Pauli groups, which were originally introduced to explain the spin of quantum particles, although the mathematical treatment of four dimensions historically traces back to quaternion formulations.



$$\sigma_X = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$\sigma_Y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

$$\sigma_Z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

Fig. 14: Pauli groups σ_X, σ_Y, σ_Z (spin representation).

Nevertheless, this remains a hypothetical structure, as the complete mathematical matrix has not yet been fully developed. Individual sections corresponding to physically realizable behaviors, however, can be constructed independently.

This framework is compatible with several fundamental physical behaviors. It encompasses behaviors like the Lorentz transformation and Minkowski diagram to explain the spacetime deformations (via rhomboidal space deformations); supersymmetry to explain the symmetry between bosons and fermions (via symmetry groups); photons' creation due to the Dynamical Casimir effect; antimatter survival while other structures like the pions are unstable; the ice rules observed in molecular systems with internal spins and geometric constraints that produce periodic lattices; emergent patterns like fractals and crystalline structures, based on parallelepiped shapes with a repetitive arrangement of atoms in unit cells, among other related phenomena

4.2 Fundamental interactions (2)

The only way to unify the nuclear force and the quantum vacuum is through **motion**. Such motion is responsible for generating the electromagnetic field as a continuous flow and for inducing particle decay that results from continuous vacuum instabilities. There are important theories about these effects in which motion is primordial, such as the QCD vacuum, the QED vacuum, or the decay through the false vacuum.

The resulting group can be reduced to matter and energy in perpetual motion. The Big Bang event produced the initial state of high density and temperature, generating the energy required to set all matter in motion and to sustain the ensuing interactions through the effectively unbounded inertia provided by the quantum vacuum. Consequently, phenomena such as field propagation, mass acquisition, and particle decay can be understood as emergent expressions of this self-sustaining equilibrium, governed by the intrinsic symmetries and nonlinear dynamics that characterize the vacuum itself.

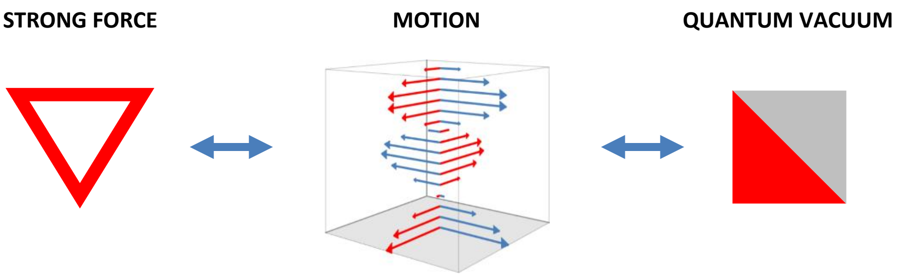


Fig. 15: Theory of Everything scheme.

The thermodynamic properties of the early quantum vacuum, governed by radiation and pressure, may have generated the primordial conditions required for biogenesis. These conditions could have promoted the molecular compaction necessary for the formation of stable DNA double helices within chromosomes, a process often identified as the origin of biological homochirality and potentially influenced by quantum superposition phenomena. The subsequent emergence of multicellular organisms, such as early worms (sharing approximately 70% of their genetic material with humans) suggests an evolutionary continuity that positioned these species as forerunners of most modern animal taxa.

In contemplating the future, if hidden variables do not exist and the scientific method is grounded in determinism, one might conceive of an absolute determinism in which neither chaos nor free will exists and all outcomes are predetermined, and overcome the resulting sense of inevitability by imaging ways to inject indeterminacy, such as: this is a cycle in an acyclic universe (so we start from a blank canvas inside a cosmos that does not repeat); through the overwhelming information content of the cosmos (all the photons from all the stars can't be predetermined); we are a tool capable of changing the probabilities of such determinism (strengthened by consciousness); or God (if we are an expression from the vacuum, there is something that can feel inside it);… And looking back to the past, remember all the discussions about ethics to distinguish right from wrong, and its association to physical or divine terms to create laws governing life in society.

From now on, I only hope to have contributed to raising your consciousness level, offering you a better understanding of your environment and our place within it.

5. Conclusions

In philosophy, **Occam's razor** (also known as the principle of parsimony) is the problem-solving principle that recommends searching for simpler explanations constructed with the smallest possible set of elements or fundamental concepts, since such explanations tend to yield more coherent and reliable results than more complex alternatives. This principle has been of capital importance in the development of science.

The theoretical framework presented can explain behaviors such as:

- The gravitational force, understood as an interaction between the strong nuclear force and the quantum vacuum, going so far as to explain quarks motion and the electromagnetic field generation, until obtaining a unified field theory.
- Dark matter due to quantum vacuum densities. Recent studies have associated the cosmic microwave background (CMB) with dark matter behavior [3]; thus, the cosmic microwave background should be related to the quantum vacuum and its energetic density. The universe is anisotropic (is not uniform in all directions).
- Dark energy and cosmic inflation. The behavior of each individual container (QDS) implies a spin-based repulsion contributing to its expansion, strong enough to avoid joining and be able to reestablish its structure after any contraction; this mechanism generates the required propagation force over large distances to allow the expansion of the universe. Recent studies analyzing more than 1.500 supernovae indicate that this expansion is not uniform and varies with time, thereby calling into question the constancy of the gravitational constant [2].
- Black holes as a density break. When the concentration of the vacuum becomes sufficiently intense, its internal repulsion may overcome the strong nuclear bonds, causing their rupture and the subsequent release of energy that leads to new internal concentrations. Just inside its Schwarzschild radius a black hole varies its nuclear density starting from a minimum of 4×10^{19} kg/m^3, more extreme than our nuclear density of $2{,}3 \times 10^{17}$ kg/m^3. Any structure smaller than a container, such as neutrinos, can escape and be transported through the vacuum; photons depending on the size and geometry of each container, can also alter their trajectory.
- Particles decay due to the vacuum interaction. This idea corresponds to current theories describing the decay of the false vacuum, a not so stable vacuum that allows the disintegration of particles; in this context, the conversion of a neutron into a proton may be due to a very weak polarization of the vacuum , possibly influenced by our position within a region of the universe exhibiting such polarization (remember that the neutron is not considered a neutral charge, but a dipolar charge composed of two equal and opposite electric charges).
- Gravitational time dilation arises from the coupling of each container with spacetime. As the frame size increases, its energy concentration decreases; therefore, spatial displacements require crossing fewer frames, effectively producing a slower temporal flow relative to regions of higher energy density. In this way, each container can be considered the smallest measurable time interval (a concept explored since Zeno's paradoxes (430 BC)).

- The gravitational constant ($G = 6{,}67408(31) \times 10^{-11}\ m^3kg^{-1}s^{-2}$), vacuum permittivity ($\varepsilon_0 = 8{,}8541878128(13) \times 10^{-12}\ F \cdot m^{-1}$), or vacuum permeability ($\mu_0 = 1{,}25663706212(19) \times 10^{-6}\ N \cdot A^{-2}$) and the problems to measure with high accuracy since they can be affected by density variations. Even small modifications in the speed of light can be expected due to the vacuum-related spin; in fact, the speed of light can be calculated based on the previous variables about vacuum permittivity and permeability using Maxwell's equations, $c=1/\sqrt{(\varepsilon_0\mu_0)}$.
- Conservation of angular momentum at bodies' rotations in space producing spherical and circular movements at planets and galaxies ($L = I \times \omega$). Applying this principle to the Big Bang implies that the formation of the universe did not require an equal distribution of matter and antimatter, suggesting that antimatter was not essential to its creation, although it is possible that a small fraction was generated during the initial explosion.
- Variations of Einstein's mass–energy equivalence equation ($E = mc^2$) can be used to define the rest energy of matter. For instance, it may be expressed as $E = AF_p$ where A represents the number of nucleons in the atomic nucleus and F_p is the nuclear energy per nucleon.
- Compatibility with light–matter interactions as described by quantum field theory (QFT) [6] and quantum electrodynamics (QED) vacuum theories. It aligns with fundamental principles such as the Pauli exclusion principle, which states that electrons cannot occupy the same quantum state, and with phenomena such as light refraction. Moreover, it is consistent with the wave function formalism and with the Schrödinger and Dirac equations, which describe the temporal evolution of a quantum system through quantum oscillators.
- Planck length ($\ell_P = 1{,}616255(38) \times 10^{-35}$ m) and Planck time ($t_P = 5{,}391247(60) \times 10^{-44}$ s) are theoretically considered the quantization of space and time and may point to the vacuum structures by length as well as time. Planck's derivations are based on relativistic parameters, which may introduce limitations in accuracy; for instance, gamma rays possess some of the smallest known wavelengths, shorter than 10^{-11} meters, far from the minimum Planck sizes.
- The residual strong force (the bond between protons and neutrons), which is much weaker than the fundamental strong interaction, has a correlation between up and down quarks that can be perfectly electromagnetic, as initially postulated in early nuclear models.
- Similarities between Newton's and Coulomb's law, as Einstein's relativity and Maxwell's equations, all of which operate consistently under the same spacetime transformation principles; Fleming's left-hand rule, used in electromagnetism, may, for example, have its origin in the rotational dynamics of the earth within the universe and consequently be related to Maxwell's stress–energy tensor.
- The unidirectional arrow of time (time moves in one direction, from past to future).
- …

6. Considerations

Gravitomagnetism (GEM) is a term that refers to the kinetic effects of gravity in analogy to the magnetic effects of a moving electric charge. In this section, we will create a relativistic relation to extract the corresponding magnetic moment and analyze its behavior independently of GEM equations, concentrating kinetic energy into a localized region to recover its potential form.

Matter can be accelerated within a chamber surrounded by magnetic coils designed to maximize the conversion of matter into energy. The chamber must possess sufficient width and height to concentrate internal energy and enable the study of how the quantum vacuum responds to intense curvature. The structure should be made from a material with the highest possible magnetic permeability under strong magnetic fields, pure iron may serve as a reference, though other high-permeability materials could also be suitable. As centrifugal effects tend to drive matter outward during acceleration, a stabilizing magnetic field is necessary to maintain confinement.

As an example, we'll calculate the energy of a single rotating disk, considering a radius r and a height h of 50 cm each, composed of iron with a density $\rho = 7{,}874\ gr/cm^3$. The corresponding mass is given by:

$$V = \pi \times r^2 \times h = 392.700\ cm^3 \qquad (8.1)$$

$$m = V \times \rho = 392.700 \times 7{,}874 = 3.092.119{,}8\ gr = 3.092{,}119\ kg$$

Given a maximum speed **at the disk periphery** (*3×10^7 m/s*), we compare the disk's kinetic energy with the maximum energy predicted by a relativistic approximation.

Vacuum density may change in connection with the electromagnetic flux

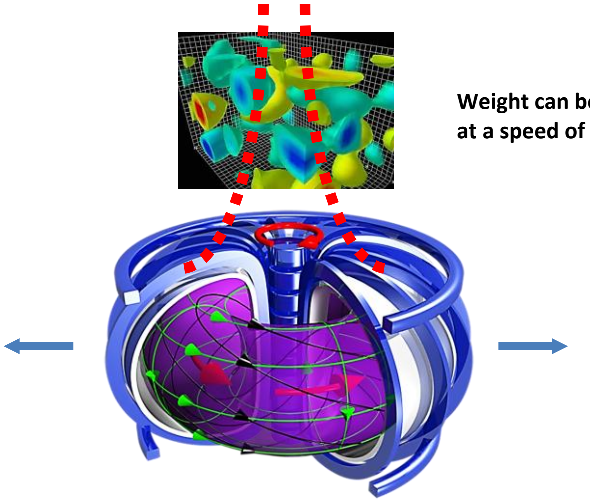


Fig. 17: Motion and relativity relation.

$v = 3 \times 10^7$ *m/s* (near the speed of light) *(8.2)*

$E_k = ½mv^2$	$E = mc^2$
$E_k = ½ \times 3.092,119 \times 9 \times 10^{14}$	$E = 3.092,119 \times 9 \times 10^{16}$
$E_k = 13.914,535 \times 10^{14}$	$E = 27.829,071 \times 10^{16}$

Even at those speeds, we are far from reaching the theoretical maximum energy.

The calculated energy is magnetically related to the particle's motion, its charge (q) and the magnetic field (B) determine its velocity through v = qBr / m, so the energy can be determined once a given speed is reached using a relativistic approximation.

$E = ½mv^2 = q^2B^2r^2 / 2m$

The limits of this confinement system are set by the strongest magnetic fields we can generate, the heat the chamber materials can withstand, and the energy density the system can reach before the structure or the magnetic field fails. Magnetic confinement breaks down once the magnetic pressure becomes greater than the material's strength, causing instability or quenching. At extremely high field strengths (around $10^9$to 10^{10}tesla), similar to those near magnetars the vacuum itself can begin to polarize. Detecting this would require very precise measurements of how light moves through the region, such as changes in refractive index, birefringence, or photon–photon scattering predicted by QED. Even small departures from normal electromagnetic behavior could indicate vacuum polarization or a slight change in spacetime geometry. Experiments like these would offer an indirect way to study how the quantum vacuum responds to extreme energy densities (in fact, variations in QCD have been observed in baryon resonances).

Some experimental systems aim to extract energy from the vacuum using metamaterials or high-intensity lasers, but these approaches are still in the research stage. Even if successful, this would only be the first step, because the extracted energy would need to be redirected to create a **Warp drive** (Alcubierre drive). In such a drive, differences in energy density around a body could allow motion through spacetime. A Warp drive requires a region of negative energy, an idea derived from the stress-energy tensor (Tμv) in Einstein's field equations.

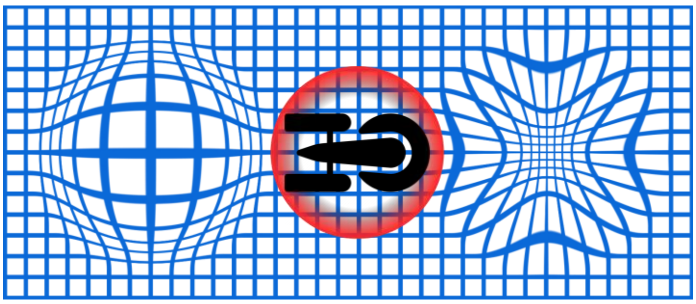


Fig. 18: Warp drive

In addition, there exists what is known as the **'vacuum catastrophe'** due to the discrepancy of approximately 122 orders of magnitude between the calculated limits for this density, depending on the method of estimation (whether the calculation begins with the Planck scale or with the cosmological constant). This discrepancy is known as the worst theoretical prediction in the history of physics.

$\rho_{vac} = \frac{c^5\hbar}{G^2} = \frac{m_l}{l^3} = 5{,}16 \times 10^{93}\ \mathrm{g/cm^3}$ Density normalized using Planck (ħ) *(9.1)*

$\rho_{vac} = 5{,}83 \times 10^{-30}\ \mathrm{g/cm^3}$ Density normalized using the Cosmological Constant (Λ)

Again, according to our model, this magnitude may not be accurately characterized since the corresponding density could be interpreted either as an adiabatic transformation (analogous to that occurring in gases) or as a negative hydrostatic pressure (similar to that found beneath the ocean surface but acting in the opposite direction).

At present, there are no comprehensive studies capable of verifying the actual correlation between the quantum vacuum and the strong nuclear force. The motion, together with the vacuum contraction and energy extraction/insertion, is likely associated with a change in density **beyond current theoretical understanding.** Furthermore, the possible **variations** in the proton radius under different conditions remain unknown, hindering the development of new and accurate calculations, an indication that we are dealing with extremely complex dynamic scales. This framework can be regarded as highly complex and conceptually challenging.

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