INTRODUCTION TO THE

THEORY OF ELECTROGRAVITATION

- MATRIX AND SIMULATION -

WORKING PAPER VERSION 5-VI°

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Fortis imaginatio generat casum.

Michel de Montaigne

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Abstract

In the first part of **Chapter 1**, the "conversion factors" are derived, which are dimensionless coefficients used to evaluate the effect of the accelerated expansion of spacetime on measurements. These factors can be expressed using a common parameter, denoted by the letter α, which is subsequently shown to be the fine-structure constant. The latter can be expressed as the ratio, raised to the fourth power, between the theoretical universe radius R_{uT} and the measured universe radius R_{uI}.

$$\alpha = \left(\frac{R_{uT}}{R_{uI}}\right)^4 \approx \left(\frac{13.6\ Gly}{46.5\ Gly}\right)^4 \approx \frac{1}{137} \tag{1.21}$$

The hypothesis of matter contraction is then discussed: the Hubble's law alone does not allow us to distinguish whether it is the universe that is expanding or the matter within it that is contracting. In this perspective, the redshift observed by Hubble reflects not the expansion of the universe, but the contraction of matter, and therefore of the "ruler" with which measurements are made. The limits of observability of the universe are then explored, and in the final part, the application of the conversion factors in the hypothesis of contracting matter is discussed, extending their validity to each singularity. In **Chapter 2**, it is demonstrated that dark matter and dark energy do not exist. Considering the abundance of dark energy in the universe ($\approx 68\%$), if we divide this value by the conversion factor ($1/2\alpha \approx 68.5$), we realize that it is nothing but ordinary energy ($\approx 1\%$), whose value is erroneously detected due to the distance between the observer and the events. A similar reasoning applies to dark matter. We are told that it contributes to 27% of the observed gravitational effects in the entire universe and that it constitutes about 85% of the mass of a galaxy. By dividing these values by the conversion factor ($1/2\sqrt{\alpha} \approx 5.85$), we obtain exactly the percentage of ordinary matter that constitutes the universe ($\approx 4.6\%$) and the galaxies ($\approx 15.5\%$), respectively. This implies that, for both the universe as a whole and in the context of a single galaxy, about 85% of the mass does not exist, and the gravitational effects attributed to it are actually caused solely by ordinary matter. Lastly, by summing the percentage values of ordinary mass and energy, derived from observations of dark matter and dark energy, we obtain a total of 5.6%, which does not differ much from the 5% of the Λ-CDM model. The other 95% does not exist as matter, but only as "effects" due to the spacetime distance separating the observer and the measured events. In **Chapter 3**, Newtonian gravitation theory is reformulated as Newtonian electrogravitational theory. It begins with the Stoney units, natural units definable using only principles of classical physics. These include the units of length (l_S), energy (E_S), and Stoney mass (m_S). The latter connects mass and energy to the elementary electric charge (charge-energy-mass equivalence law).

$$m_z = -\sum_{j=1}^{n} \frac{K}{c^2}\frac{q_e^+ q_e^-}{a_k l_S} = m_S \sum_{j=1}^{n} \frac{1}{a_k} \qquad (a_k \in \mathbb{N}) \tag{3.4}$$

In this way, a generic mass m_z can be expressed in terms of the Stoney mass unit. This relation tells us that the mass of a system composed of non-interacting elementary dipoles ($a_k = 1$), must necessarily be a multiple n_i: ($n_i \epsilon \mathbb{N}$) of the Stoney mass. This concept is integrated into the gravitational attraction law to obtain

$$\boldsymbol{F} = -G\frac{\left[-n_1\left(\frac{K}{c^2}\frac{q_e^+q_e^-}{l_S}\right)\right]\left[-n_2\left(\frac{K}{c^2}\frac{q_e^+q_e^-}{l_S}\right)\right]}{r^3}\boldsymbol{r} \tag{3.8}$$

the Newtonian electrogravitational attraction law. In **Chapter 4**, Newton's theory is extended into the generalized gravitational theory (of which Newtonian theory represents a limiting case). In the generalized gravitational theory, it is assumed that gravitational interactions are mediated by two force fields, the gravitational field **g** and the cogravitational field **K**. As in the Newtonian case, it is possible to formulate the generalized theory in terms of fields, in this case **g** and **K**. This leads to four differential equations, called Jefimenko's equations, which constitute the gravitational analog of Maxwell's equations. The generalized gravitational theory, formulated in this way, predicts a wide range of phenomena, including the existence of gravitational waves. By integrating the Stoney mass unit into the generalized gravitational theory, the latter transforms into the generalized electrogravitational theory. Jefimenko's equations are then converted into electrogravitational equations (shown below, 4.8-4.11), among which solutions include electrogravitational waves.

$$\nabla \cdot \mathbf{g} = -\frac{4\pi GK}{c^2}\frac{q_e^2}{l_S}\rho_n \tag{4.8}$$

$$\nabla \cdot \mathbf{K} = 0 \tag{4.9}$$

$$\nabla \times \mathbf{g} = -\frac{\partial \mathbf{K}}{\partial t} \tag{4.10}$$

$$\nabla \times \mathbf{K} = -\frac{4\pi GK}{c^4}\frac{q_e^2}{l_S}\boldsymbol{J}_n + \frac{1}{c^2}\frac{\partial \mathbf{g}}{\partial t} \tag{4.11}$$

Electrogravitational waves indicate that the photon γ^0 and the graviton g^0 describe two aspects of the same particle, the graviphoton $g\gamma^0$. In **Chapter 5**, Planck's law is derived from first principles. The energy of the electrogravitational wave varies based on its position in spacetime. When the wave propagates on the horizon of a singularity (quantum or black hole), its energy, as measured by an external observer (positioned outside the singularity's cone of influence), is given by the relation:

$$E_S = \frac{\mu_e GK}{2c^3}\left(\frac{q_e^2}{l_S}\right)^2 \nu = \mu_e c\frac{q_e^2}{2}\nu = \frac{Z_0 q_e^2}{2}\nu = h_S\nu \tag{5.5}$$

Here, E_S is the Stoney energy, $h_S \approx 4.84 \cdot 10^{-36}\, J \cdot \mathrm{s}$ is the Stoney constant, v is the frequency, and Z_0 is the impedance of free space. When the wave propagates in locally flat spacetime, its energy is approximately $(1/\alpha \approx 137)$ times greater:

$$E_P = \frac{1}{\alpha}\frac{\mu_e GK}{2c^3}\left(\frac{q_e^2}{l_S}\right)^2 v = \mu_e c \frac{q_e^2}{2\alpha} v = \frac{Z_0 q_e^2}{2\alpha} v = \frac{h_S}{\alpha} v = h_P v \tag{5.6}$$

Here, E_P represents the Planck energy and $h_P \approx 6.626 \cdot 10^{-34}\, J \cdot \mathrm{s}$ is the Planck constant. When a graviphoton is absorbed by an elementary particle, such as an electron, the energy it contributes to the system is (for an external observer) approximately $(1/\alpha \approx 137)$ times less than the energy possessed by the graviphoton in locally flat spacetime. If we use the Stoney constant instead of the Planck constant in the calculation of the energy levels of the orbitals in atoms, there is no need to introduce α. In **Chapter 6**, the electrogravitodynamic equations are developed, which describe the propagation of the scalar and vector potentials, and the stress-energy tensor. Finally, in **Chapter 7**, the electrogravitational field eq. is presented.

$$R_{\mu\nu(f)} - \frac{1}{2} g_{\mu\nu(f)} R = \frac{32\pi^2 G_{(f)} K_{(f)}}{\mu_{e(f)} c_{(f)}^6} T_{\mu\nu(f)} \tag{7.2}$$

Here, the subscript (f) indicates the dependence of the different terms on their respective conversion factors, implicitly highlighting their relationship with the fine-structure constant α. The left-hand side of the equation remains unchanged (even in derivation) compared to that developed by Einstein: all terms present are continuous quantities. The right-hand side, however, is quantized. Quantization of the left-hand side is achieved by extracting the length unit l_u from the tensor $T_{\mu\nu}$ (which can only take values between l_S and l_P), and placing it (its square) in the numerator on the left-hand side, thereby discretizing the elements $R_{\mu\nu}$ and $g_{\mu\nu}$. In this way, a fully quantized (and dimensionless) version of the electrogravitational field eq. is obtained.

$$l_{u(f)}^2 R_{\mu\nu(f)} - \frac{l_{u(f)}^2}{2} g_{\mu\nu(f)} R = \frac{32\pi^2 G_{(f)} K_{(f)}}{\mu_{e(f)} c_{(f)}^6} l_{u(f)}^2 T_{\mu\nu(f)} \tag{7.3}$$

In this equation, $1/l_{u(f)}^2$ represents the "curvature quantum," expressed in terms of the minimum measurable length (to achieve true quantization in terms of graviphoton charges, the length unit must be divided by 2). This can be compactly expressed as (7.4). The solutions to Einstein's field equation are represented by the spacetime metrics. In the electrogravitational case, since the field equation is quantized, the solutions are also found to be quantized. These solutions allow us to address phenomena from both a relativistic and quantum-mechanical perspective. In **Chapter 8**, the steps leading to our current understanding of matter are retraced, from the establishment of the concept of atoms to elementary particles. Subsequently, the possibility that elementary particles themselves are composed is examined and discussed: the electrogravitational theory suggests that the graviphoton is formed by two oppositely charged electric charges. Similar to how various elements in the periodic table trace back to the hydrogen atom, elementary particles can be traced back to the elementary electric charge $q_e^{-/+}$. Within atoms, electrons occupy orbitals that necessarily have opposite spins (Pauli exclusion principle). A similar scenario applies to elementary particles: they lack a nucleus (the role of which is taken by the charge center), and instead of electrons, their orbitals are occupied by elementary electric charges. In the case of elementary particles, a principle akin to exclusion applies directly to the sign of charges: within the same orbital, only charges (bosons) of opposite signs (-/+) can coexist. A fully filled orbital results in a neutral elementary particle, while a single unpaired charge results in either a (-) particle or a (+) antiparticle. With only 10 available slots (?), there are 10 possible elementary particles, 4 bosons, and 6 leptons. The filling of orbitals among elementary particles results in each particle differing from the next by exactly one elementary electric charge. Therefore, we can assign a parameter analogous to atomic number, the charge number (n_c), to particles (including non-elementary ones). The proton and neutron each consist of 3 leptons with $n_c = 3$, held together by a free delocalized elementary electric charge. This molecular model will be used in **Chapter 9** to calculate the ratio of the proton mass (m_P) to the electron mass (m_e). The mass difference between these subatomic particles arises because the 3 leptons (in the form of up/down quarks) that constitute the proton, during rotation, each fall within the influence cone of the adjacent lepton (quark), which does not occur in the case of the 3 charges of the electron as they rotate around their charge center. The ratio (m_P/m_e) is calculated using the formula (only one quark at a time interacts):

$$\frac{m_P}{m_e} = R \cdot \left(\frac{1}{f[\boldsymbol{F}]}\right)^N = R \cdot \left(\frac{1}{\sqrt{\alpha}}\right)^N \approx 1.1466 \cdot (11.7)^3 \approx 1836 \qquad (9.4)$$

Here, $\sqrt{\alpha}$ corresponds to (for an observer "external" to the singularity's influence cone) the conversion factor for force. R is the ratio between the average charge number of one of the particles composing the proton ($\bar{n}_c = 10.3\overline{3}/3 \approx 3.44$) and the charge number of the electron ($n_c = 3$), and N is the ratio between the number of quasi-particles composing the proton (3) and the number of particles composing the electron (1). In **Chapter 10**, the concept of force is revisited: from a quantum perspective, force is nothing but the effect that occurs due to the exchange of particles, thus called mediators. Since all particles can be exchanged, all are carriers of force. In **Chapter 11**, the theory of the multiverse with repeated gravitational collapses (like Matrioshka) is presented. Our universe would be part of a black hole that formed approximately 13.6 billion years ago in a higher (parent) universe, through the gravitational collapse of a sufficiently massive star present there. Our universe resides within a larger universe and contains, in turn, other universes. In this perspective, our universe represents just one of the many levels (realms) that make up the multiverse, all separated by horizons (boundaries), which are simultaneously event horizons (for an external observer) and cosmological horizons (for an internal observer). For an observer approaching a horizon, crossing this boundary would never occur because the horizon continues to move until it disappears from the observer's view (the horizon thins out like a fog bank). Viewing the multiverse as a series of repeated gravitational collapses connects to the concept of "eternal recurrence." This concept states that all events repeat over time after a certain period (return period), similarly, in an infinite cycle, like seasons (Ouroboros). In **Chapter 12**, the steps leading to the birth of information theory are retraced. Everything, whether sounds, images, or texts, can be digitized and transmitted as bits, using a system capable of assuming at least two states. To force a system into a specific state, energy must be supplied, hence energy and information are interconnected concepts. It has always been clear that creating physical order, such as building architectural or digital structures, incurs an energy cost. Moreover, despite the abstract nature of information, it must be embodied in a physical system. Information must be "contained" by something, whether it's a stone slab, a book, a CD, or any other medium. This raises the question of whether there exists a fundamental level at which information can be encoded, the level of fundamental "0" and "1." This can only be spacetime itself (electrogravitational field). We have seen how the smallest fluctuation of spacetime corresponds to the elementary electric charge, which therefore represents the "curvature quantum" (with the sign corresponding to that of the fluctuation). The field assumes the value "0" where undisturbed and "1" where an elementary electric charge is present. The entire reality is thus a vast dynamic matrix (binary or ternary, depending on whether the signs of charges are considered). The total curvature of the field (mass) is given by the sum of all charges, regardless of their sign, and thus by all those points of the non-zero field. Furthermore, since charge is conserved, information must also be conserved:

$$n(1) + n(-1) = 0 \tag{12.1}$$

For $(n \in \mathbb{N}) = 1$, this reduces to the constitutive relation of the graviphoton, represented by the string (-1;1). Summarizing, everything that exists can be reduced to atoms, atoms to subatomic particles, subatomic particles to elementary particles, elementary particles to elementary electric charges, and finally these to the bits of the program (field) we call "reality". The universe, matter, energy, spacetime, are essentially computational: everything is made of rules, laws, strings (each particle can be equated to a numeric string). This demonstrates that the universe is nothing more than a vast program, an illusion interpreted as real by our brains. According to digital physics, this inevitably implies the existence of an external "programmer" who has devised the simulation in which we live. In this sense, human consciousness is not part of spacetime, it interacts with the world through a system of input and output, similar to what happens with computer programs, interacting with the physical world through the senses. Consciousness is thus "causality" originating outside spacetime. Furthermore, considering that a bit represents a choice between two states, this implies that the universe is fundamentally dual at its elementary level. Duality underpins the dynamics of physical systems. Without opposites, there would be no differentiation, no forces, and everything would be inert. Duality is a symmetry law that applies to every entity and every level of existence. Everything that exists has formed and forms through consecutive ramifications (divisions or symmetries), like the branches of a tree. Hence arises the parallel with the tree of life. All existence can be traced back to a single root, the electrogravitational field. In this sense, elementary electric charge (q_e) represents the cell (fundamental unit) of spacetime.

Introduction

Since ancient times, the nature of space and time has been a central theme in natural philosophy. Galileo [1] and Newton [2] conceived space as a static, immutable, and continuous container in which natural events unfold, within which absolute time flows uniformly and continuously at all points. In Newton's theory, the structure of space was described by Euclidean geometry (itself based on the assumption of continuity). Newton's hypothesis of the continuity of space and physical quantities (continuity of observables) led to the development of infinitesimal calculus, which in turn contributed to the construction of the imposing edifice of classical physics, from its origins to the theory of relativity. The subsequent interpretation of electromagnetic phenomena through Maxwell's laws [3] led to the definition of a new physical entity, the electromagnetic field. Maxwell's theory, too, was based on the idea of the continuity of space and time. An interesting aspect is that classical physics reveals [4], through its equations, a perfectly predictable universe in its evolution, deterministic. A true revolution in the understanding of the nature of space and time occurred with Einstein's theory of special relativity [5] (published in 1905). Einstein's theory replaced Newton's absolute space and time with a spacetime continuum. Special relativity also led to the equivalence between mass and energy. Subsequently, Einstein further extended the principle of relativity to all reference systems, including accelerated ones. This led him to formulate the theory of general relativity [6] (published in 1916), in which the gravitational field is interpreted as the curvature of spacetime. Despite the revolutionary conception of the nature of space and time presented in this theory, it remains firmly tied to the principle of determinism that characterizes classical physics. Regarding the nature of matter, Democritus was the first to propose the concept that matter is composed of atoms. Experimental confirmation of the existence of atoms came in the early 1900s [7]. There was, however, a problem. While matter appeared discontinuous, Maxwell's theory described light and electromagnetic phenomena as continuous. This problem was resolved in 1900 by Max Planck [8], who hypothesized a granular nature for energy as well. Einstein later used this hypothesis to explain the photoelectric effect [9]. This marked the beginning of quantum mechanics. Within quantum theory emerges a fundamental symmetry of reality, the granularity of matter and energy. The introduction of the concept of the quantum of light by Einstein in the context of the photoelectric effect highlighted the simultaneous existence of the photon both in the theory of special relativity as a wave and in quantum theory as a particle. The extension of this duality to all matter, proposed by Louis de Broglie [10], highlighted the inadequacy of the then-existing mathematical framework, developed within the realm of classical physics, to describe this new entity consisting of the wave-particle duality. The main problem lay in the concept of action itself. In quantum mechanics, the relationship between spatial coordinate and momentum is governed by Heisenberg's uncertainty principle [11]. This principle tells us that the phase space

area is bounded from below by the action quantum. In other words, phase space is pixelated [12]. This led to the need for a new mathematics, primarily developed by Schrödinger [13] and Heisenberg [14]. Bohr [15] understood that the representation of the atomic world based on his hypothesis of electron stationary states did not allow the creation of a spacetime model centered on Newtonian principles (determinism). In fact, any attempt to fix the coordinates of particles constituting an atom would ultimately lead to an uncontrollable exchange of energy and momentum. The existence of stationary states in the atom, and the possibility for an electron to "jump" between states with the emission of a photon, in Bohr's representation, is justified by the hypothesis that not only the energy of the photon is quantized, but also its orbital angular momentum. This highlights that, at the elementary level, various mechanical quantities are inherently discontinuous. At the time of Planck, the following constants of nature were known*, the universal gravitational constant G, introduced by Newton, the Coulomb constant K, the speed of light in vacuum c, measured and deducible from Maxwell's equations, and the action quantum h. It was Planck himself [16], inspired by George Stoney's earlier work [17], who noticed that these could be combined in such a way as to derive natural units of mass, length, and time.
*There was also the electric charge q_e, but this was not used by Planck in formulating his system of natural units. The three quantities immediately proved suitable for constituting a system of absolute units. The physical significance of Planck units began to become clear only with the developments of relativity theory in relation to quantum mechanics. If we have managed to reconcile special relativity with quantum mechanics (quantum electrodynamics), it is precisely thanks to the natural measurement units introduced by Planck. Conversely, in attempting to combine quantum mechanics with general relativity, we immediately encounter limitations imposed by the uncertainty principle, which leads to defining lower limits for observations. From the 1980s onward, many theoretical physicists focused on formulating a theory that could reconcile quantum mechanics and general relativity. General relativity describes the gravitational field in geometric terms, using the notion of spacetime curvature and, as such, it is not a quantized theory. The quantization of the gravitational field implies identifying the particle associated with the field, the graviton [18]. This process is not as straightforward as it might seem. Many difficulties in constructing a quantum theory based on general relativity arise from disparities in the reality view of each theory. Quantum field theory describes particles in terms of fields propagating in the flat spacetime of special relativity, that is, Minkowski spacetime. For general relativity, however, the graviton represents the elementary fluctuation (quantum) of spacetime itself, and not of another field. Moreover, since the conditions under which quantum effects on gravity become evident are beyond the reach of experiments, there is no data that can shed light on how spacetime behaves at the Planck scale. A first reconciliation between general relativity and quantum mechanics was achieved by Jacob Bekenstein [19] and Stephen Hawking [20], who intuitively grasped that black holes could be described thermodynamically. However, it is now established that the two theories must

somehow coexist at the Planck scale, where they must give rise to quantum gravity. According to some, the definition of absolute units of length and time highlights that spacetime exhibits a certain discontinuity in its elementary structure. This hypothesis has given rise to various versions of quantum gravity, including that proposed by string theory [21]. In this theory, particles are nothing more than different vibrational modes of these strings. It also predicts the existence of the graviton, the quantum of the gravitational field, with zero mass and Spin 2, which represents the analogue of what the photon is for the electromagnetic field. Just as photons are the "building blocks" of electromagnetic waves, gravitons would represent the constituents of gravitational waves (predicted by general relativity as perturbations of spacetime propagating at the speed of light). This text presents a unified theory that integrates quantum mechanics and general relativity. We will see how the smallest fluctuation of spacetime, the "curvature quantum," is identified with the elementary electric charge, with its sign corresponding to that of the perturbation. Moreover, the graviton and photon turn out to be the same particle, the graviphoton, which consists of two elementary electric charges of opposite sign. The graviphoton acts as a mediator for both the electromagnetic field and the gravitational field. In this way, these two fields are merged into a single entity, the electrogravitational field. Furthermore, since all matter can be converted into graviphotons, in the universe there exists nothing but elementary electric charges, which, when combined, form the entire reality.

NOTE: The introduction has been adapted from “La discontinuità della Natura” by Marco Capogni [*], published on INFN, Scienza per tutti. The citations present in the text have been added subsequently and are not part of the original article.

1. Conversion factors

1.1 The origin of the universe

There are numerous stories that attempt to narrate the origin of the universe in a mythological sense [22]. In some of these, its birth is attributed to the creative intervention of a supreme God who created everything from nothing, while in others, it is believed that something has always existed. Mythological-like images of the universe's origin have been described by astrophysicists since the 1930s. During those years, the idea of a preexisting singularity emerged, from which the entire universe would have developed following the Big Bang, becoming manifest because it emitted light. This idea stems from the attempt to integrate into the cosmological theories of the time the observations regarding the recession velocities of galaxies [23].

1.2 The observable universe

In cosmology, the term "observable universe" refers to that portion of the universe that can be examined by a specific observer. Every point in space has its own observable region. If the universe (light sphere) had expanded linearly (at a constant speed c), its radius would equal the distance traveled by light during the entirety of its existence. In other words, the horizon of the observable universe would be approximately [24] 13.6-13.8 Gly from the point of observation. However, due to accelerated expansion, the actual size of this horizon is larger. Some estimates [25] suggest that space could have expanded to about 46.5 Gly. Since the expansion is still ongoing, this means that the limit of the observable universe continues to shift. Beyond this boundary, every object is receding from the observer at speeds greater than that of light (a situation similar, but opposite, to that of a black hole [26]). This limit represents the maximum distance with which causal contact is possible.

1.3 Conversion factors

We ask whether the effect of the accelerated expansion of the universe acts only on the position and recession velocity of cosmic objects [23] (and thus on the value of the radius of the observable universe), or also on other types of observations (conducted on a cosmic scale and otherwise). To assess the influence of the accelerated expansion of the universe (interpreted as the expansion of spacetime) on measurements, we can compare what we observe at the limits of our observable universe (at distances $R_{uI} \approx 46.5\,Gly$), with what we would have expected to observe if the expansion had occurred and were still occurring linearly (at a constant speed equal to the speed of light c). By taking the ratio of these two measurements, we obtain dimensionless coefficients, the conversion factors. We denote by uI the values actually observed (which include a component due to the accelerated expansion of spacetime), and by uT the (theoretical) values that would have been expected to be measured at the boundaries of our observable universe. In this way, we obtain two sets of measurements, whose only common element is time, 13.6 Gy (we will use the value obtained from WMAP data [27]). Below are some of the conversion factors. Their numerical value is accompanied by the corresponding value in units $\alpha \approx 1/137$. Subsequently, the equivalence of the parameter α with the fine-structure constant will be demonstrated. Other conversion factors can be deduced through the combination of those listed. It is also possible to obtain unitary values that are invariant regarding the accelerated expansion of spacetime.

1) Conversion Factor for Time. The conversion factor for time is defined as the ratio between the measured and theoretical age of the universe; by definition, it equals 1.

$$f[t] = \frac{T_{uI}}{T_{uT}} = \frac{13.6\ \text{Gy}}{13.6\ \text{Gy}} = 1 \tag{1.1}$$

2) Conversion Factor for Lengths. The conversion factor for lengths is determined by taking the ratio between the measured and theoretical radius of the universe.

$$f[l] = \frac{R_{uI}}{R_{uT}} = \frac{46.5\ \text{Gly}}{13.6\ \text{Gly}} = \frac{1}{\sqrt[4]{\alpha}} \approx 3.42 \tag{1.2}$$

3) Conversion Factor for Velocities. The conversion factor for velocities is defined as the ratio between the expansion velocities of the two universe models.

$$f[\boldsymbol{v}] = \frac{\boldsymbol{v}_{uI}}{\boldsymbol{v}_{uT}} = \frac{f[l]}{f[t]} = \frac{1}{\sqrt[4]{\alpha}} \approx 3.42 \tag{1.3}$$

4) Conversion Factor for Accelerations. The conversion factor for accelerations has the same value as that for lengths, since the conversion factor for time is $f[t] = 1$.

$$f[\boldsymbol{a}] = \frac{\boldsymbol{a}_{uI}}{\boldsymbol{a}_{uT}} = \frac{f[l]}{f^2[t]} = \frac{1}{\sqrt[4]{\alpha}} \approx 3.42 \tag{1.4}$$

5) Conversion Factor for Curvature. This conversion factor is determined by the ratio between the squares of the theoretical and measured radii of the universe.

$$f[S] = \frac{S_{uI}}{S_{uT}} = \frac{R_{uT}^2}{R_{uI}^2} = \frac{1}{f^2[l]} = \sqrt{\alpha} \approx \frac{1}{11.7} \tag{1.5}$$

6) Conversion Factor for Gravitational Attraction Force. The conversion factor for gravitational attraction force is equal to the inverse square of the conversion factor for lengths. This is because, according to general relativity, Gmm is an invariant [28].

$$f[\boldsymbol{F}_g] = \frac{\boldsymbol{F}_{g\,uI}}{\boldsymbol{F}_{g\,uT}} = \frac{1}{f^2[l]} = \sqrt{\alpha} \approx \frac{1}{11.7} \tag{1.6}$$

7) Conversion Factor for Energy. The conversion factor for energy can be derived from the conversion factors for force and length.

$$f[E] = \frac{E_{uI}}{E_{uT}} = f[\boldsymbol{F}_g] \cdot f[l] = \sqrt[4]{\alpha} \approx \frac{1}{3.42} \tag{1.7}$$

8) Conversion Factor for Mass. The conversion factor for mass can be calculated from the conversion factors for energy and velocity.

$$f[m] = \frac{m_{uI}}{m_{uT}} = \frac{f[E]}{f^2[\boldsymbol{v}]} = \sqrt[4]{\alpha^3} \approx \frac{1}{40} \tag{1.8}$$

9) Conversion Factors for the Gravitational Constant 'G', Permittivity, and Gravitational Permeability. The conversion factor for the gravitational constant 'G' is obtained by combining the conversion factors for force, length, and mass. The conversion factor for gravitational permittivity is simply its inverse.

$$f[G] = \frac{G_{uI}}{G_{uT}} = \frac{f[\boldsymbol{F}_g] \cdot f^2[l]}{f^2[m]} = \frac{1}{\alpha\sqrt{\alpha}} \approx 1600 \tag{1.9}$$

$$f[\varepsilon_g] = \frac{\varepsilon_{g\,uI}}{\varepsilon_{g\,uT}} = \frac{1}{f[G]} = \alpha\sqrt{\alpha} \approx \frac{1}{1600} \tag{1.10}$$

The conversion factor for gravitational permeability is deduced by combining the conversion factors for velocities and for gravitational permittivity ε_g.

$$f[\mu_g] = \frac{\mu_{g\,uI}}{\mu_{g\,uT}} = \frac{f[\varepsilon_g]}{f^2[\boldsymbol{v}]} = \frac{1}{\alpha} \approx 137 \tag{1.11}$$

10) Conversion Factor for Coulomb Force. The conversion factor for Coulomb force must be identical to that for gravitational attraction force. This principle applies, in general, to every quantity that has the dimensions of force.

$$f[\boldsymbol{F}_e] = \frac{\boldsymbol{F}_{e\,uI}}{\boldsymbol{F}_{e\,uT}} = \frac{1}{f^2[l]} = \sqrt{\alpha} \approx \frac{1}{11.7} \tag{1.12}$$

11) Conversion Factor for Electric Charge. The conversion factor for electric charge can be determined by considering that the conversion factor for the electric field $\boldsymbol{E}$ must necessarily be unity. This is because electric fields, unlike gravitational fields whose variations have led to postulating the existence of dark energy and dark matter, do not show anomalies. This is evidenced by measurements of the CMB, which is homogeneous and isotropic on a large scale [29].

$$f[q] = \frac{f[\boldsymbol{F}_e]}{f[\boldsymbol{E}]} = f[\boldsymbol{F}_e] = \frac{q_{uI}}{q_{uT}} = \sqrt{\alpha} \approx \frac{1}{11.7} \tag{1.13}$$

12) Conversion Factors for Coulomb's "Constant", Electric Permittivity, and Magnetic Permeability. The conversion factor for Coulomb's "constant" K is derived from the conversion factors for force, length, and electric charge. The conversion factor for electric permittivity is its inverse.

$$f[K] = \frac{K_{uI}}{K_{uT}} = \frac{f[\boldsymbol{F}_e] \cdot f^2[l]}{f^2[q]} = \frac{1}{\alpha} \approx 137 \tag{1.14}$$

$$f[\varepsilon_e] = \frac{\varepsilon_{e\,uI}}{\varepsilon_{e\,uT}} = \frac{1}{f[K]} = \alpha \approx \frac{1}{137} \tag{1.15}$$

The conversion factor for magnetic permeability is deduced by combining the conversion factors for velocity and electric permittivity ε_e.

$$f[\mu_e] = \frac{\mu_{e\,uI}}{\mu_{e\,uT}} = \frac{f[\varepsilon_e]}{f^2[\boldsymbol{v}]} = \frac{1}{\sqrt{\alpha}} \approx 11.7 \tag{1.16}$$

1.4 Unitary conversion factors

It is important to note that since Hubble's law [23] is a linear relationship, it is possible to divide the conversion factors for the radius of the observable universe $R_{uI} \approx 46.5\,Gly$, in order to obtain unit conversion factors (expressed in m^{-1}). These indicate how much measurements must be corrected for every meter between the observer (0) and the event location (d). This effect is so small that a photon emitted with $\lambda = 1m$ and detected 1m away from the emission point undergoes a wavelength increase of only $7.8 \cdot 10^{-27}m$. A photon emitted with a wavelength of $1m$ at the edge of our observable universe is detected here on Earth with a wavelength of 3.42 meters. These effects are so small that they are detectable only on a cosmic scale or in systems characterized by significant spacetime curvature, such as black holes.

However, we will see later how it is precisely the combination of these effects that determines all those phenomena falsely attributed to dark matter and energy, and which influence the value of the Planck constant. They are listed in the appendix.

1.5 Equivalence between α and the fine-structure costant

The fine-structure constant, denoted by the Greek letter α', represents the coupling constant of electromagnetic interaction. It is a dimensionless quantity with a value of approximately $1/137$. It was introduced by Arnold Sommerfeld [30] as a measure of the relativistic deviation of spectral lines of the Bohr atom. To demonstrate that the parameter α, introduced earlier, is equivalent to the fine-structure constant α', let's consider a generic electromagnetic field. This field is associated with a total energy density equal to $|\boldsymbol{S}|/c$. Our aim is to understand how its presence relativistically modifies spacetime. To do this, we use Einstein's field equation. When propagating through vacuum, the electromagnetic field does not perceive effects related to the accelerated expansion of spacetime, as light maintains its constant speed while crossing expanding space. Therefore, the quantities used to describe the field are of type uT (concepts introduced in Paragraph 1.8 are used).

$$G_{\mu\nu(uT)} = \frac{8\pi G_{uT}}{c_{uT}^4} T_{\mu\nu(uT)} \tag{1.17}$$

Let's now suppose that the field is absorbed (in the form of photons) by matter. Even though the field no longer exists as such, it still contributes to the energy of the system of which it is now a part, and therefore to the curvature of that region of spacetime. Consequently, the units must be converted from uT to uI, since matter perceives the passage of time and the accelerated expansion of the universe. Now, using the conversion factors (appendix), let's calculate the ratio between the energies.

$$\frac{\int \rho_{E_{uI}}\, dV}{\int \rho_{E_{uT}}\, dV} = f[E] \cdot f^{-3}[l] = \alpha \tag{1.18}$$

This ratio turns out to be equal to α. Here, V represents the integration volume measured in an external reference frame, so its value is the same before and after the interaction (it does not depend on conversion factors). When it is stated that the fine-structure constant represents the interaction constant between light and matter, there is an implicit reference to the ratio between the electrostatic energy accumulated by an electron (in Bohr's model) and the quantum energy possessed by the incident photon [31]. Put simply, an electron accumulates less energy than that possessed by a photon in vacuum. This means that the contribution of the field to the relativistic curvature of that particular region of spacetime is also less. If ρ_{E_0} and ρ_E are the energy densities of the field before and after the interaction, we can write [32]:

$$\frac{\int \rho_E \, dV}{\int \rho_{E_0} \, dV} = \alpha' \tag{1.19}$$

Therefore, the variation predicted by the conversion factors is effectively the same as that observed in the interaction between light and matter. Thus we can write:

$$\alpha = \alpha' \tag{1.20}$$

Since this reasoning holds generally, it must also apply to an electromagnetic field such that its curvature radius (assuming spherical symmetry) is, before and after the interaction, equal to the theoretical radius R_{uT} and the measured radius R_{uI} of the universe. From this, it follows that the fine-structure constant can be expressed as:

$$\alpha = \left(\frac{R_{uT}}{R_{uI}}\right)^4 \approx \left(\frac{13.6 \text{ Gly}}{46.5 \text{ Gly}}\right)^4 \approx \frac{1}{137} \tag{1.21}$$

1.6 IS THE UNIVERSE REALLY EXPANDING?

As we have seen, the accelerated expansion of the universe is a fundamental concept in cosmology. It is based on the observation that galaxies are moving away from each other in a manner proportional to their distance. However, in the absence of an absolute reference point in the universe, Hubble's law alone does not allow us to distinguish whether the universe itself is expanding or if the matter within it is contracting [33]). In other words, while we see galaxies moving away from each other, we cannot say with certainty whether each galaxy is moving away or if the matter that composes them is falling towards the "infinitely" small (spacetime and matter are the same thing: matter is nothing but a fluctuation/ripple in the fabric of spacetime). To consider the universe as expanding, we must postulate the existence of an invisible source of energy [34] (dark energy). On the other hand, considering the matter falling [35] towards the "infinitely" small, allows us to extend the concept of gravitational fall and, secondly, as we will see, provides a theoretical basis for deriving the exact value of the quantum of action from first principles. From this perspective, the redshift observed by Hubble reflects not the expansion of the universe, but the contraction of matter and, consequently, of the "ruler" with which measurements are made. Every point in spacetime contracts by the same amount, and it is the presence of mass (energy) that locally accelerates this contraction. The contraction of the "ruler" can only be accelerated, but not slowed down (negative masses and energies do not exist). This effect has a substantial impact in all those regions where there are high concentrations of mass and energy, such as in galaxies (the differential contraction of spacetime between the periphery and the center leads to the postulation of additional matter, the dark matter) and quantum singularities.

1.7 The observability limits of the universe

The idea that matter contracts, rather than the universe expanding, leads to the conclusion that it is not photons traveling away from their point of emission, but the emitter itself moving away, due to its contraction, at the speed of light. In this scenario, a photon represents a stationary excitation of spacetime; in fact, for a photon, time does not pass. The contraction of spacetime also implies the existence of regions that contract at speeds greater than c (relative to an external observer). These regions are the quantum singularities, which correspond to the elementary electric charges; they are separated from the observable universe by the quantum limit, beyond which even light cannot penetrate. The cosmic horizon and the quantum horizon constitute, respectively, the upper and lower limits of observability of our universe. Beyond these, there are two other limits: the limit represented by the "event horizons" of black holes and the limit of the light spheres of past events. In the latter case, the primordial light sphere coincides with the cosmic horizon. Due to the speed of light, these limits are physically identical. Their union forms the "limit (or horizon) of observability" of the universe. Every observer has their own horizon of observability, which also depends on their state of motion and that of other bodies.

1.8 Extension of conversion factors

In the case of a contracting universe (matter), the conversion factors can be reinterpreted as coefficients that allow us to convert observational results to account for the effects related to the contraction of spacetime. We have seen that there are four insurmountable horizons in the universe, imposed by the speed of light. Therefore, we can extend the concept of conversion factors to each of the singularities (this concept was already used in Paragraph 1.5, where it was introduced for the calculation of the fine-structure constant α). These coefficients, as defined, allow us to translate a measurement taken by an observer located at the center of a singularity of an event placed on the outer horizon of the same, where the component due to the contraction of spacetime on the measurement is maximal, into a local measurement (in which this component is negligible or absent). The unit conversion factors allow us to correct these effects for observations made at intermediate distances (between the observable horizon of the singularity and its center). For an observer at the center of a singularity (thus at the center of the celestial sphere, a black hole, a quantum singularity, or a sphere of light), the conversion factors for observations towards the respective horizons should be applied as previously defined: as the observation distance increases, the observer will see the recession velocity of bodies grow linearly, as happens with galaxies. Conversely, for an observer located on the horizon or completely outside the cone of influence of a singularity, the conversion factors should be applied in reverse (looking towards the center of the singularity, the observer will see the velocity of bodies decrease, as happens with the rotation curves of galaxies). These coefficients are in the appendix.

2. Dark energy and matter

2.1 The recession velocity of galaxies

To explain the observed recession velocity of galaxies, which increases linearly with increasing observational distance, the existence of dark energy is postulated [34]. However, it is the effects due to the contraction of spacetime (matter), occurring between the point where the event is located (the galaxy whose velocity is being measured and the source of the observed light, most likely near the cosmic horizon) and the point of observation, that create the illusion that the galaxies are moving away (at speeds up to approximately $v \approx 3.42\ c$). In fact, it is the observer (matter), positioned at the center of their celestial sphere (universe), who is accelerating (relative to the cosmic horizon) their own fall [35] towards the "infinitely" small.

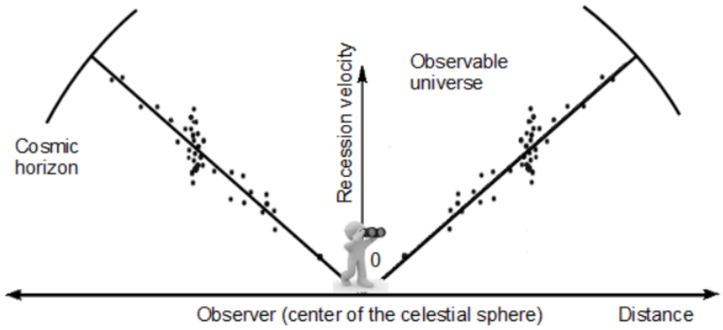


Fig.1

Let's imagine we have two spheres of equal mass, separated by a certain distance, here on Earth. Now, suppose we instantaneously move one of the two spheres near the cosmic horizon. Then, we observe, from Earth, the force with which these spheres attract each other in the new configuration. After correcting the measurements for all other effects, we will still observe a discrepancy between the measured and expected values. The attractive force between the two spheres will be less intense by a factor of $1/\sqrt{\alpha} \approx 11.7$. There will be no variations observed in the physics of the system, as the Coulomb attraction force also varies in the same manner. Specifically, we will see the distance separating the two spheres expanded by a factor of $1/\sqrt[4]{\alpha} \approx 3.42$ (indeed, we will measure a value of $46.5\ Gly$ for the radius of the universe instead of $13.6\ Gly$). The mass of the sphere placed on the horizon will appear smaller by a factor of $1/\sqrt[4]{\alpha^3} \approx 40$, while the constant "*G*" will appear increased by a factor of $\alpha\sqrt{\alpha} \approx 1600$. Furthermore, since looking towards the cosmic horizon is equivalent to looking into the past [36], this means that in ancient times the various units and physical constants had, from the perspective of a present-day observer, different values. Obviously, since the impact of spacetime contraction on the measurements increases linearly with the distance of the observation, its effects will also increase linearly. In this way, a linear increase in the recession velocity of galaxies is observed.

2.2 DARK ENERGY DOES NOT EXIST

Physical laws tell us that an increase in the recession velocity of an object implies that the object must also have greater kinetic energy, $E = 1/2\, mv^2$. The kinetic energy of galaxies is estimated [37] based on their recession velocity (obtained through redshift measurements) and their mass (evaluated based on their rotational velocity or luminosity). The constant increase in the recession velocity of galaxies does not seem to have a detectable causal source, and is therefore attributed to an invisible (dark) energy that permeates the entire universe. Observations tell us that the universe is composed of 68% dark energy and only about 1% ordinary energy. However, we know that for events far from the observer's location, just as velocities appear dilated, masses and energies will appear reduced. The measured energy (from Earth) of galaxies positioned on the cosmic horizon is reduced by a factor of $1/\sqrt[4]{\alpha} \approx 3.42$ for each of the four components of the velocity vector (since galaxies are not only receding longitudinally from the observer but also, on a large scale, from each other and over time). Therefore, the conversion factor for energy (its inverse) must be raised to the fourth power and divided by 2 (since the average value for a linearly growing function is its maximum value divided by 2), as the measurements extend from the center of the celestial sphere to the edges of the observable universe.

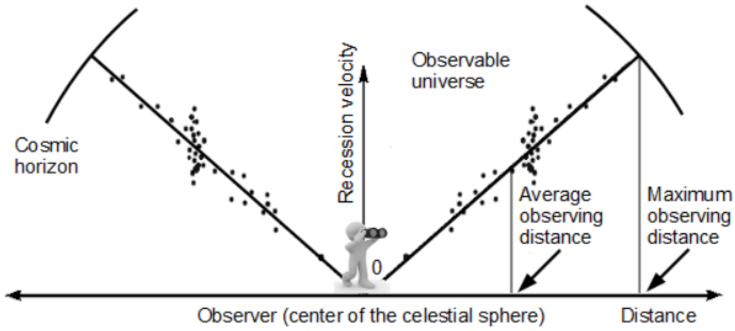


Fig.2

$$\bar{f}^{-1}[E(m, \boldsymbol{v})] = \frac{1}{2} \cdot \left(\frac{1}{\sqrt[4]{\alpha}}\right)^4 = \frac{1}{2\alpha} \approx \frac{137}{2} \approx 68.5 \qquad (2.1)$$

Knowing the abundance of dark energy in the universe (68%), if we divide this value by the coefficient we just derived (68.5), we see that it is nothing more than ordinary energy (1%), whose value is erroneously detected due to the spacetime distance interposed between the observer and the observed events.

$$Ordinary\ energy\ in\ the\ universe \approx 68\% \cdot 2\alpha \approx 68\% \cdot \frac{2}{137} \approx 1\% \qquad (2.2)$$

2.3 THE ROTATION CURVES OF GALAXIES

In the case of galaxy rotation curves, to explain the discrepancy which increases moving from the center towards the outer regions, between the observed velocity and the expected velocity (of celestial bodies) based on visible matter (stars and gas), the existence of dark matter is postulated [39]. However, it's not the periphery that contains additional matter (dark matter), but rather the center that appears more massive, approximately 40 times more for an observer located in the galactic periphery or completely outside the influence cone of the black hole (singularity). To illustrate this concept, we can perform the two-sphere thought experiment again.

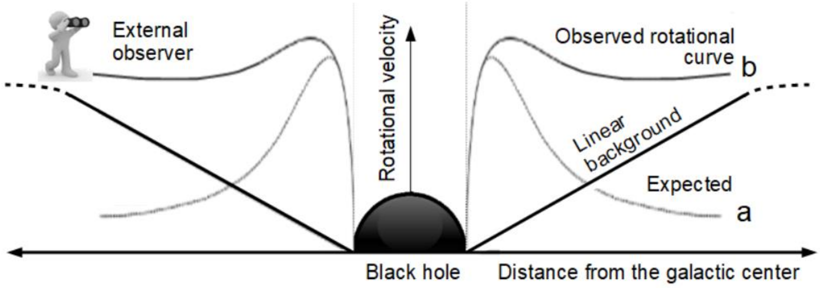


Fig.3

On Earth (galactic periphery), the two spheres interact reciprocally with a force determined by the universal law of gravitation. Now, imagine moving one sphere near the event horizon of the black hole (located at the center of our Milky Way) and observing, from Earth, the force with which these spheres attract each other. Once again, after correcting the measurements for all other effects, we will observe a stronger force by a factor of $1/\sqrt{\alpha} \approx 11.7$. In detail, the measured distance between the two spheres will appear shorter by a factor of $1/\sqrt[4]{\alpha} \approx 3.42$. The mass of the sphere placed on the event horizon will appear greater by a factor of $1/\sqrt[4]{\alpha^3} \approx 40$, while the gravitational attraction constant "G" will appear smaller by a factor of $1/\alpha\sqrt{\alpha} \approx 1600$. Therefore, between our observation point (flat spacetime) and the cosmic horizon (origin of times), the same effects exist on measurements, but in reverse, compared to those between our observation point and the center of the Milky Way (event horizon), or between any galactic periphery and its center (event horizon). These effects manifest on everything within the influence cone. Celestial bodies present in galaxies, such as stars, planets, and other cosmic objects, will experience the effects of differential spacetime contraction due to the black hole, relative to the distance that separates them from it. As a consequence, all parameters associated with them measured by an external observer will appear distorted. For an observer in the galactic periphery, the velocity of celestial objects near the event horizon will appear approximately $1/\sqrt[4]{\alpha} \approx 3.42$ times lower (per component) compared to the value measured by an observer located on the horizon itself. This creates the illusion that objects in the periphery have additional velocity (attributed to the presence of invisible matter, the dark matter). This occurs because the rotation curve of galaxies is estimated [40] based on the "apparent" gravitational force exerted by the center, which is overestimated for an external observer (for example, on Earth) by a factor of $1/\sqrt{\alpha} \approx 11.7$. Naturally, since the influence of the singularity decreases as we move towards the periphery, its effects on observations will also diminish. Therefore, if a galaxy's mass is primarily due to the black hole, a linear background will be observed in the rotation curve, which can be removed using conversion factors. In this case (and only in this case), at the galaxy's edges, at the limits of the black hole's influence cone where spacetime can be considered flat, there will be a ratio between the measured velocity (by an external or periphery observer) and the expected velocity, approximately equal to $b/a \approx 3.42$ (per component). In cases where the mass of other bodies present in the galaxy is not negligible, the observed peripheral velocity will be higher (with a ratio $b/a > 3.42$), making the measurement correction more challenging (since the background will contain as many small contributions as there are bodies in the galaxy, whose parameters appear distorted due to the central singularity). Indeed, in larger galaxies, a significant discrepancy is observed between expected and measured peripheral velocities [41].

2.4 Dark matter does not exist

To refute the existence of dark matter, it is essential to consider the conversion factor for force. Using only the conversion factor for mass is inadequate because mass is estimated through gravitational force measurements. This coefficient must then be divided by 2 (average value for a linear function). Calculating the average value is crucial because the influence of spacetime contraction on measurements decreases

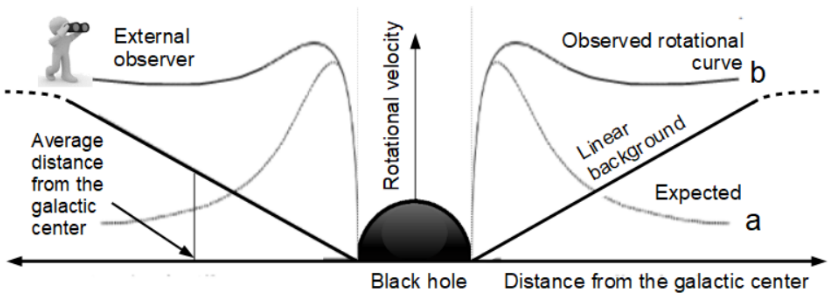


Fig.4

moving from the event horizon out to the periphery. The average value is the same, whether we consider a single galaxy or the universe, so the calculation is the same.

$$\bar{f}^{-1}[m(\boldsymbol{F}_g)] = \frac{1}{2\sqrt{\alpha}} \approx \frac{11,7}{2} \approx 5.85 \tag{2.3}$$

We are told that dark matter contributes to 27% of the observed gravitational effects in the entire universe and constitutes approximately 85% of the mass of a galaxy [42].

Dividing these values by the found conversion factor (5.85), we obtain exactly the percentage of ordinary matter that makes up, respectively, the universe and galaxies.

$$Ordinary\ matter\ in\ the\ universe = 27\% \cdot 2\sqrt{\alpha} \approx 27\% \cdot \frac{2}{11.7} \approx 4.6\% \quad (2.4)$$

$$Ordinary\ matter\ in\ a\ galaxy = 85\% \cdot 2\sqrt{\alpha} \approx 85\% \cdot \frac{2}{11.7} \approx 15.5\% \quad (2.5)$$

This implies that, both for the universe as a whole and within the context of a single galaxy, 85% of the mass (on average) does not exist, and the gravitational effects attributed to it are actually caused solely by ordinary matter. The influence of ordinary matter diminishes with distance less than expected, due to the effects related to spacetime (matter) contraction that takes place between the event and the observer.

2.5 Matter and energy of the universe

By summing the percentage values of ordinary mass (4.6%) and energy (1%) of the entire universe derived from measurements of dark energy and matter, we obtain a total of 5.6%, which approximates the 5% of the Λ-CDM model [43]. The remaining 95% does not exist as matter, but only as effects due to the distance of observation.

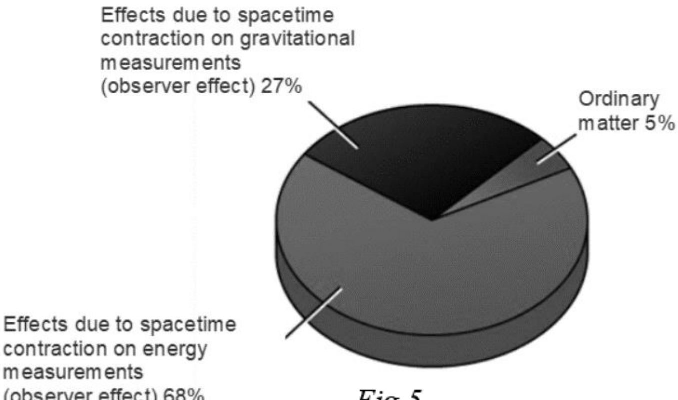


Fig.5

Normalizing these values relative to 100%, we obtain a new estimate, derived from measurements of dark matter and energy, of the quantities of ordinary matter and energy present in the universe.

$$Ordinary\ matter\ in\ the\ universe = \left(\frac{100\%}{1.0\% + 4.6\%}\right) \cdot 4.6\% \approx 82.0\% \quad (2.6)$$

$$Ordinary\ energy\ in\ the\ universe = \left(\frac{100\%}{1.0\% + 4.6\%}\right) \cdot 1.0\% \approx 18.0\% \quad (2.7)$$

3. Newtonian Electrogravitational Theory

3.1 Charge-energy-mass equivalence

In 1874, George Johnstone Stoney proposed units of measurement based solely on the charge of the electron and the physical constants G, K, c [17]. Unlike Planck units, these units are based solely on classical physics concepts. Stoney's idea stemmed from the observation that electric charge always appears as a multiple of a minimum quantity, meaning it is quantized. He hypothesized the existence of an irreducible quantity for each physical entity. Stoney defined his unit of length l_S by combining the constants G, K, c and the charge of the electron (elementary electric charge) q_e.

$$l_S = \sqrt{\frac{GK}{c^4} q_e^2} \approx 1.38 \cdot 10^{-36}\, m \tag{3.1}$$

Now, given two elementary electric charges of opposite sign (arranged in a dipole configuration) separated by a distance equal to the Stoney lenght l_S, the energy stored in such a system is called Stoney energy E_S, which is the maximum amount of energy that can be stored in an elementary dipole.

$$E_S = -K \frac{q_e^+ q_e^-}{l_S} \approx 1.7 \cdot 10^8 \text{ J} \tag{3.2}$$

From the theory of special relativity [5], we know that there is a close relationship between mass and energy (expressed by the mass-energy equivalence). Therefore, we can associate a corresponding mass with Stoney energy, the Stoney mass m_S.

$$m_S = -\frac{K}{c^2} \frac{q_e^+ q_e^-}{l_S} \approx 1.86 \cdot 10^{-9}\, kg \tag{3.3}$$

Stoney's mass represents the maximum value for the mass of an elementary dipole: all other masses can be expressed in relation to m_S. This equation connects mass and energy to the charge. Therefore, a generic mass m_z can be expressed in terms of m_S.

$$m_z = -\sum_{j=1}^{n} \frac{K}{c^2} \frac{q_e^+ q_e^-}{a_k l_S} = m_S \sum_{j=1}^{n} \frac{1}{a_k} \qquad (a_k \in \mathbb{N}) \tag{3.4}$$

In the case where $a_k = 1$, it tells us that the mass of a system consisting of elementary electric dipoles considered non-interacting (since the distance between one dipole and another is always several orders of magnitude greater than the Stoney lenght), must be an integer multiple n_i (where $n_i \in \mathbb{N}$ is the number of dipoles) of the Stoney mass. *The Stoney (or Planck) mass represents the mass of the photon. Defining a mass for the photon (graviphoton) is itself a consequence of the special relativity [5], which allows assigning a corresponding mass to energy. It is possible to overcome this incompatibility by considering that, although a photon cannot possess rest mass (also due to the uncertainty principle ?), it is still possible to assign it a gravitational mass. Finally, it must be remembered that relativistically, mass remains an invariant; what changes is the factor γ, which does not apply in this case. The mass of the graviphoton cannot be considered a simple mathematical artifice (?).

3.2 Newtonian electrogravitazional theory

The classical theory of gravitation is based on Newton's law [2]. It states that the gravitational force of attraction between two bodies is directly proportional to their masses and inversely proportional to the square of their distance between them:

$$\boldsymbol{F} = -\,G\frac{m_1 m_2}{r^3}\boldsymbol{r} \tag{3.5}$$

This can be reformulated [44] as a field theory, in terms of the field vector **g**:

$$\nabla \times \mathbf{g} = 0 \tag{3.6}$$

$$\nabla \cdot \mathbf{g} = -4\pi G\rho \tag{3.7}$$

In the second equation, $\rho = dm/dV'$ represents the mass density, which is given by the ratio between the mass element dm and the volume element dV' that contains it. Now, having introduced the unit of mass (Stoney mass), we can integrate it into Newton's equation, in order to obtain a partially quantized expression (numerator). In the case of systems consisting of non-interacting dipoles, Newton's law becomes:

$$\boldsymbol{F} = -\,G\frac{\left[-n_1\left(\frac{K}{c^2}\frac{q_e^+ q_e^-}{l_S}\right)\right]\left[-n_2\left(\frac{K}{c^2}\frac{q_e^+ q_e^-}{l_S}\right)\right]}{r^3}\boldsymbol{r} \qquad (n_i \in \mathbb{N}) \tag{3.8}$$

The quantization is applied only to the masses, as this allows us to develop the theory so that it can later be fully integrated into general relativity. In general, the force $\boldsymbol{F}$ acting on a mass with dipole density ρ''_n located in the gravitational field **g** is given by the modified Jefimenko equation [45]:

$$\boldsymbol{F} = \int \rho\mathbf{g}\,dV = \frac{K}{c^2}\frac{q_e^2}{l_S}\int \rho''_n\left[-\frac{GK}{c^2}\frac{q_e^2}{l_S}\int\frac{\rho'_n}{r^3}\,\boldsymbol{r}\,dV'\right]dV \tag{3.9}$$

where the integration is extended over the space occupied by the mass experiencing the force due to the gravitational field **g** created by the dipoles with density ρ'_n. In this way, we can define the gravitational field vector as:

$$\mathbf{g} = -\frac{GK}{c^2}\frac{q_e^2}{l_S}\int \frac{\rho'_n}{r^3}\, \boldsymbol{r}\, dV' \tag{3.10}$$

here r is the distance from the source point where **g** is measured or calculated. The integral is extended over all space. The mass density ρ and the dipole density ρ_n are related by the following mass density-dipole density (or graviphoton) relation.

$$\rho = -\frac{K}{c^2}\frac{q_e^+ q_e^-}{l_S}\, \rho_n = \frac{K}{c^2}\frac{q_e^2}{l_S}\rho_n \tag{3.11}$$

where $\rho_n = dn/dV'$ is given by the ratio between the dipole element dn and the volume element dV' that contains it. For practical applications of Newton's theory and particularly in celestial mechanics, the vector **g** is rarely calculated directly. Often, the gravitational potential φ is calculated, which is related to **g** through:

$$\mathbf{g} = -\nabla\varphi \tag{3.12}$$

The potential is related to the dipole density ρ_n by the equation:

$$\nabla^2\varphi = 4\pi G\rho = \frac{4\pi GK}{c^2}\frac{q_e^2}{l_S}\rho_n \tag{3.13}$$

By integrating (3.13), we obtain the equation for the electrogravitational potential:

$$\varphi = -\frac{GK}{c^2}\frac{q_e^2}{l_S}\int \frac{\rho_n}{r}\, dV' \tag{3.14}$$

which, for a "point-like" mass (n represents the number of elementary dipoles), is:

$$\varphi = -\frac{GK}{c^2}\frac{q_e^2}{l_S}\frac{n}{r} \tag{3.15}$$

The equations presented so far have intentionally not been simplified in order to show both "constants," that of gravitational attraction “G” and that of Coulomb “K” The same approach has been adopted in subsequent chapters and in the entire text.

4. Generalized Electrogravitational Theory

4.1 LIMITATIONS OF NEWTONIAN THEORY

We know that Newton's Theory of Gravitation has clear shortcomings [45], among which is its inability to explain certain fine details of planetary motions. In fact, it represents a theory of gravitational state rather than a theory of gravitational process, as it does not provide any information about the temporal aspect of gravity. When applied to time-dependent systems, it is incompatible both with the principle of causality and with the conservation law of momentum.

4.2 COGRAVITATIONAL FIELD

It is well known that there is a strong resemblance between the equations of Newton's gravitational theory and the equations of electrostatics. It is also well known that in Maxwell's electromagnetic theory, the conservation law of momentum is satisfied because time-dependent electromagnetic interactions involve not only the electric field but also the magnetic field. Therefore, we can suppose [45] that time-dependent gravitational interactions, just like electromagnetic interactions, are also mediated by a second force field, the "cogravitational field," denoted by the symbol **K**. This field is created only by moving masses and acts exclusively on moving masses. This field, not considered in Newtonian theory, was proposed in 1893 by Oliver Heaviside [46]. In this way, it is possible to generalize Newton's theory of gravitation, thereby eliminating the aforementioned shortcomings and making it fully applicable to all possible gravitational systems and interactions.

4.3 GENERALIZED ELECTROGRAVITATIONAL THEORY

Accepting the existence of the cogravitational field, and expressing the fields **g** and **K** in terms of retarded integrals, it is possible to develop and reformulate Newton's single-field theory so that it becomes a special case of the generalized gravitational theory. In this way, the generalized theory of gravitation, made coherent with the special theory of relativity, becomes fully compatible with the laws of conservation of energy and momentum. The generalized theory of gravitation therefore assumes that gravitational interactions are mediated by two force fields, the gravitational field **g** and the cogravitational field **K**, which are defined as such (by Jefimenko in "*Gravitation and Cogravitation*") [45]:

$$\mathbf{g} = -G \int \left\{ \frac{[\rho]}{r^3} + \frac{1}{r^2 c}\left[\frac{\partial \rho}{\partial t}\right] \right\} \boldsymbol{r}\, dV' + \frac{G}{c^2} \int \frac{1}{r} \left[\frac{\partial (\rho \boldsymbol{v})}{\partial t} \right] dV' \qquad (4.1)$$

$$\mathbf{K} = -\frac{G}{c^2}\int\left\{\frac{[\rho\boldsymbol{v}]}{r^3} + \frac{1}{r^2 c}\frac{\partial[\rho\boldsymbol{v}]}{\partial t}\right\} \times \boldsymbol{r}\, dV' \tag{4.2}$$

where $G, \rho, r, \boldsymbol{r},$ and dV' assume their usual meanings, $\boldsymbol{v}$ is the velocity at which the mass distribution ρ moves, and $p\boldsymbol{v}$ constitutes the "mass current density". From the second equation, it is evident that the field **K** is created only by moving masses and acts only on moving masses. The square brackets indicate that the enclosed quantities must be evaluated at the "retarded time" $t' = t - r/c$, where t is the time at which **g** and **K** are evaluated, and c is the speed of propagation of the fields **g** and **K**, equal to the speed of light. According to these equations, the gravitational field has three causal sources: the mass density ρ, the temporal derivative of ρ, and the temporal derivative of the mass current density $\rho\boldsymbol{v}$; while the cogravitational field has two causal sources: the mass current density $\rho\boldsymbol{v}$ and the temporal derivative of $\rho\boldsymbol{v}$. It is important to note that for stationary masses, hence independent of time, the cogravitational field calcels out ($\mathbf{K} = 0$). Furthermore, since the derivatives of ρ_n are zero, **g** reduces to the ordinary gravitational field equation of Newton's theory.

$$\mathbf{g} = -G\int\frac{\rho}{r^3}\,\boldsymbol{r}\, dV' \tag{4.3}$$

Therefore, Newton's gravitational theory represents a limiting case of the generalized theory. Finally, it is important to note that the retardation can often be neglected, and these equations can be used with non-retarded mass density and current. As in the Newtonian case, it is possible to reformulate the generalized theory in terms of fields, **g** and **K**.. In this way, we obtain four differential equations (Jefimenko equations) [45], which constitute the gravitational equivalent of Maxwell's equations [3].

$$\nabla \cdot \mathbf{g} = -\,4\pi G\rho \tag{4.4}$$

$$\nabla \cdot \mathbf{K} = 0 \tag{4.5}$$

$$\nabla \times \mathbf{g} = -\frac{\partial \mathbf{K}}{\partial t} \tag{4.6}$$

$$\nabla \times \mathbf{K} = -\,\frac{4\pi\boldsymbol{J}}{c^2} + \frac{1}{c^2}\frac{\partial \mathbf{g}}{\partial t} \tag{4.7}$$

Formulated in this way, the generalized theory of gravitation predicts a wide range of phenomena, one of the most significant being gravitational waves. By introducing the unit of Stoney mass (m_S) into these equations, we obtain the electrogravitational equations (Generalized Electrogravitational Theory).

$$\nabla \cdot \mathbf{g} = -\frac{4\pi GK}{c^2}\frac{q_e^2}{l_S}\rho_n \tag{4.8}$$

$$\nabla \cdot \mathbf{K} = 0 \tag{4.9}$$

$$\nabla \times \mathbf{g} = -\frac{\partial \mathbf{K}}{\partial t} \tag{4.10}$$

$$\nabla \times \mathbf{K} = -\frac{4\pi GK}{c^4}\frac{q_e^2}{l_S}\boldsymbol{J}_n + \frac{1}{c^2}\frac{\partial \mathbf{g}}{\partial t} \tag{4.11}$$

These equations are "invertible" and, for completeness, must always be accompanied by the gravitoelectric equations (4.8b, 4.9b, 4.10b, 4.11b; see appendix). Here the fields **g** and **K**, defined by Jefimenko for the continuous case (4.1-4.2), are described by the following relationships (locally, the generic velocity $\boldsymbol{v}$ reduces to c):

$$\mathbf{g} = -\frac{GK}{c^2}\frac{q_e^2}{l_S}\int\left\{\frac{[\rho_n]}{r^3} + \frac{1}{r^2 c}\left[\frac{\partial \rho_n}{\partial t}\right]\right\}\boldsymbol{r}\, dV' + \frac{GK}{c^4}\frac{q_e^2}{l_S}\int\frac{1}{r}\left[\frac{\partial(\rho_n \boldsymbol{v})}{\partial t}\right] dV' \tag{4.12}$$

$$\mathbf{K} = -\frac{GK}{c^4}\frac{q_e^2}{l_S}\int\left\{\frac{[\rho_n \boldsymbol{v}]}{r^3} + \frac{1}{r^2 c}\left[\frac{\partial \rho_n \boldsymbol{v}}{\partial t}\right]\right\}\times \boldsymbol{r}\, dV' \tag{4.13}$$

4.4 Electrogravitational waves

Analogously to Maxwell's equations and those of Jefimenko, electrogravitational equations also admit solutions of wave nature, known as electrogravitational waves. These tell us that electromagnetic waves and gravitational waves represent two aspects of the same physical phenomenon. The photon γ^0, a particle with $Spin$ 1, is associated with the electric fields **E** and magnetic **B**, while the graviton g^0, a particle with Spin 2, is associated with the gravitational fields g and cogravitational **K**. The latter, being represented by functions dependent on $-q^2$, always assume negative values and oscillate at double the frequency of fields **E** and **B**. The elementary charge q_e represents the integral over half a period of the oscillating charge q. The Stoney mass m_S represents the mass associated with both charges over the entire period. This implies that a complete oscillation always contains the same amount of charge and mass. The transfer of charge (q_T) and mass (m_T) from one system to another always occurs through the transfer of an integer number of elementary charges (q_e) and mass units (m_S). This results in two relations similar to Planck's equation [8], where ν represents the frequency of oscillation of the electrogravitational wave.

$$m_{T(f)} = m_{S(f)} v t \tag{4.14}$$

$$q_{T(f)} = 2 q_{e(f)} v t \tag{4.15}$$

For an electrogravitational wave propagating in flat spacetime, the Stoney mass m_S must be replaced with m_P (Planck mass) and q_e (Stoney or elementary electric charge) with q_P (Planck charge). This means that graviphotons (elementary dipoles) act as mediators of both the gravitational force and the electromagnetic force. The behavior of electric charges is described by Maxwell's equations (gravitoelectric), whereas when the phenomenon is observed from the gravitational perspective, Jefimenko's equations or general relativity must be used. If we consider Born's interpretation [47] of the wave function, the electrogravitational wave assumes the meaning of a probability map; it shows where graviphotons are most likely found.

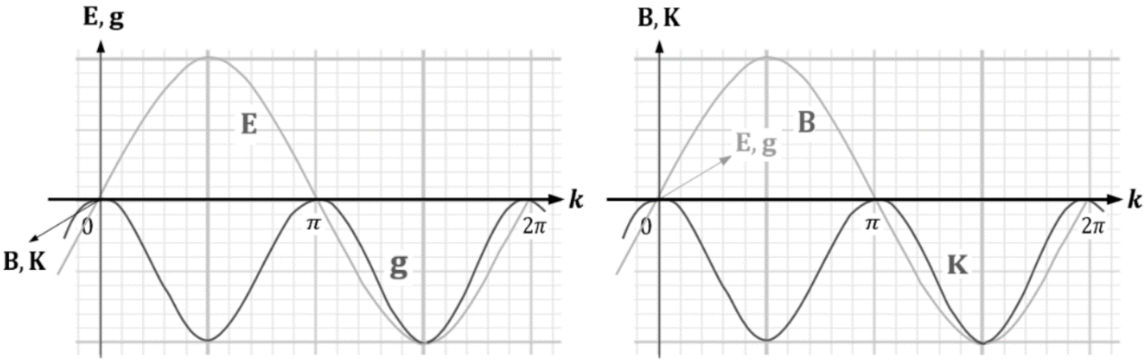


Fig.6

In electrogravitational waves, the **K** field is in phase with the **g** field, and both are in phase with the **E** and **B** fields. Additionally, since the **g** and **K** fields always assume negative values, the trajectory of light undergoes a net deviation when it propagates within a gravitational field. The electrogravitational wave also reveals that the smallest fluctuation of spacetime coincides with the elementary electric charge. As we will see in Chapter 7, the elementary electric charge represents the "quantum of curvature" of spacetime, with its sign corresponding to that of the fluctuation. If we consider spacetime as a vast ocean, elementary electric charges can be seen as bubbles/antibubbles. The total curvature of the field (mass) is given by the totality of the charges, regardless of their sign. The graviphoton $g\gamma^0$, represented in Fig.6, is therefore that elementary particle formed by the union of two charges of opposite sign. Moreover, since all matter can be converted into graviphotons, there is nothing in the universe but elementary electric charges, which combine to form the entire reality. As we will see in subsequent chapters, even the other elementary particles present in the Standard Model will be shown to be composed of elementary charges.

The ***law of conservation of graviphotons*** (or consevation law of charge-energy-mass) states that the total number "n" of graviphotons is conserved. It is defined as:

$$\frac{K}{c^2}\frac{q_e^2}{l_S}\nabla\cdot(\rho_n\boldsymbol{v}) = -\frac{K}{c^2}\frac{q_e^2}{l_S}\frac{\partial\rho_n}{\partial t} \tag{4.16}$$

The ***electrogravitational Lorentz force*** acting on a distribution of graviphotons with density ρ_n describes the behavior of graviphotons when they are in the presence of gravitational and/or cogravitational fields. The integral is extended over the region of space containing the distribution under consideration. Locally $\boldsymbol{v}$ reduces to c.

$$\mathbf{F} = \frac{K}{c^2}\frac{q_e^2}{l_S}\int \rho_n(\mathbf{g} + \boldsymbol{v}\times\mathbf{K})dV \tag{4.17}$$

The ***Poynting vector***, described by the cross product of the **g** and **K** fields, expresses the energy flux (energy per unit area per unit time) associated with the propagation of the electrogravitational field.

$$\mathbf{S} = \frac{\mu_e c^4}{16\pi^2 GK}\,\mathbf{g}\times\mathbf{K} \tag{4.18}$$

From the Poynting vector, we can derive the ***momentum density*** of the electrogravitational field, which is proportional to the Poynting vector according to the relation:

$$\rho_{\mathbf{p}} = \frac{\mathbf{S}}{c^2} = \frac{\mu_e c^2}{16\pi^2 GK}\,\mathbf{g}\times\mathbf{K} \tag{4.19}$$

where the integration is extended over the region under consideration, as well as the ***energy density*** of the field, given by the squared norm of the Poynting vector divided by c.

$$\rho_E = \frac{|\mathbf{S}|^2}{c} = \frac{\mu_e c^2}{32\pi^2 GK}(\mathbf{g}^2 + c^2\mathbf{K}^2) \tag{4.20}$$

As can be seen, most of the equations used in electrogravitational theory are essentially transformations of expressions developed within Maxwellian electrodynamics, obtained through a simple substitution of symbols.

5. Derivation of Planck's Law

5.1 Derivation of planck's law

Each particle can be seen as a point-like, isotropic emitter of electrogravitational waves (graviphotons). It is assumed that the radiated power is uniformly distributed over a spherical wavefront with surface area $A = 4\pi r^2$, where r represents the distance from the point of emission. We want to determine the amount of energy radiated by the particle in the case of monochromatic emission. In this case, it is possible to use a "simplified" version of the **g** (4.12) and **K** (4.13) fields.

$$\mathbf{g} = -\frac{GK}{c^2 r^2}\frac{q_e^2}{l_S}\, n\, \hat{\mathbf{k}}_1 = -\mathbf{g}_S n \tag{5.1}$$

$$\mathbf{K} = -\frac{GK}{c^3 r^2}\frac{q_e^2}{l_S}\, n\, \hat{\mathbf{k}}_2 = -\mathbf{K}_S n \tag{5.2}$$

Here, $\hat{\mathbf{k}}_1$ and $\hat{\mathbf{k}}_2$ represent the unit vectors associated with the fields **g** and **K**, and n is the number of graviphotons. Additionally, $\mathbf{g}_S$ and $\mathbf{K}_S$ are the gravitational and cogravitational fields in Stoney units. Given the electrogravitational Poynting vector:

$$\mathbf{S} = \frac{\mu_e c^4}{16\pi^2 GK}\, \mathbf{g} \times \mathbf{K} \tag{4.18}$$

To determine the emitted power from the source, it is necessary to integrate over the entire wavefront, which is equivalent to multiplying by the surface area ($A = 4\pi r^2$).

$$P_S = \int_A \mathbf{S} \cdot \hat{\boldsymbol{n}}\, dA = (4\pi r^2)\frac{\mu_e c^4}{16\pi^2 GK}\left(\frac{GK}{c^2 r^2}\frac{q_e^2}{l_S} n \cdot \frac{GK}{c^3 r^2}\frac{q_e^2}{l_S} n\right) \tag{5.3}$$

Considering that locally $r^2 = c^2 t^2$, we obtain the power associated with the wave:

$$P_S = \frac{\mu_e GK}{4\pi c^3}\left(\frac{q_e^2}{l_S}\right)^2 \frac{n^2}{t^2} \tag{5.4}$$

Given that $n/t = v$ represents the emission frequency of graviphotons, multiplying by $2\pi/v$ gives us the Stoney energy carried by the electrogravitational wave. Furthermore, substituting Stoney length l_S, defined (3.1) in terms of other physical constants, we derive the relation that defines the energy of the electrogravit. wave:

$$E_S = \frac{\mu_e GK}{2c^3}\left(\frac{q_e^2}{l_S}\right)^2 v = \mu_e c\frac{q_e^2}{2}v = \frac{Z_0 q_e^2}{2}v = h_S v \tag{5.5}$$

Here, h_S represents the Stoney constant, whose value is approximately $\approx 4.84 \cdot 10^{-36} J \cdot s$, and Z_0 is the impedance of free space. This is the energy possessed by the graviphoton when the wave propagates on the horizon of a singularity (for example, on the quantum horizon). In fact, this value is derived from the "physical" constants G and K, which depend on the interaction between particles. On the other hand, when the graviphoton is in a region of locally flat spacetime, its energy is approximately $f^{-4}[E] = 1/\alpha$ times higher, $E_P \approx 137 \cdot E_S$, as it does not experience the effects due to the singularity. This is the value that emerged from Planck's calculations. The energy carried by the electrogravitational wave in flat spacetime is:

$$E_P = \frac{1}{\alpha}\frac{\mu_e GK}{2c^3}\left(\frac{q_e^2}{l_S}\right)^2 v = \mu_e c\frac{q_e^2}{2\alpha}v = \frac{Z_0 q_e^2}{2\alpha}v = \frac{h_S}{\alpha}v = h_P v \tag{5.6}$$

Here, h_P represents the Planck constant, whose value is approximately $\approx 6.626 \cdot 10^{-34} J \cdot s$. To this wave is associated the Poynting vector expressed in Stoney units:

$$\mathbf{S} = \frac{1}{\sqrt[4]{\alpha^3}}\frac{\mu_e c^4}{16\pi^2 GK}\mathbf{g} \times \mathbf{K} \tag{5.7}$$

When an elementary particle (such as an electron) absorbs a graviphoton, the energy it brings to the system is 137 times smaller than the energy it possesses when propagating in vacuum (flat spacetime). Thus, the electron will absorb an energy equal to $E_S = h_s v$. In fact, if we use the Stoney quantum instead of the Planck quantum in calculating the energy levels of the atom, we do not need to introduce the fine structure constant α. The general form of the Poynting vector is given by:

$$\mathbf{S}_{(f)} = \frac{\mu_{e(f)} c_{(f)}^4}{16\pi^2 G_{(f)} K_{(f)}}\mathbf{g}_{(f)} \times \mathbf{K}_{(f)} \tag{5.8}$$

Here (f) indicates the dependence of the various terms in the equation on their respective conversion factors. The generic Poynting vector can take values between the vector obtained by substituting Stoney units inside it, and that obtained through Planck units. The same applies to the relationship between frequency and energy of the electrogravitational wave, and generally for all other equations present in the text.

$$E_{(f)} = h_{(f)} v \tag{5.9}$$

6. Electrogravitodynamic equations

6.1 Relativistic tensorial form and stress-energy tensor

Electrogravitational equations can be represented through the use of field potentials; however, this formulation introduces a certain arbitrariness in the precise form of the potentials. To ensure invariance under Lorentz transformations and obtain a relativistic formulation, the Lorenz gauge is adopted. To derive the four scalar equations that define the generalized potentials, we start from the field flux equation:

$$\nabla \cdot \left(-\nabla\phi - \frac{\partial \mathbf{A}}{\partial t}\right) = -\frac{4\pi GK}{c^2}\frac{q_e^2}{l_S}\rho_n \tag{6.1}$$

After a few steps [48], we obtain the electrogravitodynamic equations:

$$-c^2\,\nabla^2\mathbf{A} + \nabla(\nabla\cdot\mathbf{A}) \;+\; \frac{\partial\nabla\phi}{\partial t} + \frac{\partial^2\mathbf{A}}{\partial t^2} = -\frac{4\pi GK}{c^2}\frac{q_e^2}{l_S}\boldsymbol{J}_n \tag{6.2}$$

They describe the propagation of the two potentials, scalar and vector. These relations can be decoupled by exploiting the fact that the curl of a gradient is zero, and by performing the following gauge transformation [48]:

$$\mathbf{A} \to \mathbf{A} + \nabla\Psi \qquad \phi \to \phi - \frac{\partial\Psi}{\partial t} \tag{6.3}$$

where Ψ is any sufficiently regular scalar field. The new potentials satisfy the same equations as the old potentials, and in this way, the expressions for the **g** and **K** fields also remain unchanged. Through gauge invariance, it is possible to choose **A** such that it satisfies the Lorenz condition, obtained by choosing Ψ such that:

$$\nabla\cdot\mathbf{A} = -\frac{1}{c^2}\frac{\partial\phi}{\partial t} \tag{6.4}$$

This condition determines the covariant form of the electrogravitational equations for the potentials that describe the field. If the potentials satisfy the Lorenz condition, they are said to belong to the Lorenz gauge. If the Lorenz condition is satisfied, the non-decoupled electrogravitodynamic equations become two decoupled equations (6.5-6.6), corresponding to four differential equations in four unknown scalar functions [49].

$$\nabla^2\phi - \frac{1}{c^2}\frac{\partial^2\phi}{\partial t^2} = \frac{4\pi GK}{c^2}\frac{q_e^2}{l_S}\rho_n \tag{6.5}$$

$$\nabla^2\mathbf{A} - \frac{1}{c^2}\frac{\partial^2\mathbf{A}}{\partial t^2} = \frac{4\pi GK}{c^4}\frac{q_e^2}{l_S}\boldsymbol{J}_n \tag{6.6}$$

Where $\boldsymbol{J}_n = \rho_n\boldsymbol{v}_i$. It is also demonstrated that, given a particular electrogravitational problem, perfectly defined in its initial and boundary conditions, the solution is unique. More precisely, the solution to the wave equations is the retarded potentials, which in the Lorenz gauge take the form [48]:

$$\phi(\mathbf{x}, t) = -\frac{GK}{c^2}\frac{q_e^2}{l_S}\int\frac{\rho_n(\boldsymbol{r}_0, t')}{\boldsymbol{r}}dV \tag{6.7}$$

$$\mathbf{A}(\mathbf{x}, t) = -\frac{GK}{c^4}\frac{q_e^2}{l_S}\int\frac{\boldsymbol{J}_n(\boldsymbol{r}_0, t')}{\boldsymbol{r}}dV \tag{6.8}$$

where $\boldsymbol{r}$ is the distance from the observation point to the element dV, and $t' = t - r/c$ is the retarded time. The potentials A and ϕ can be seen as the components of a four-vector J^μ (the proportionality constant is implicit):

$$J^\mu = (\rho_n c, \boldsymbol{J}_n) = \rho_n(c, \boldsymbol{u}) = \rho_n\gamma(c, \boldsymbol{u}) = \rho_n u^\mu \tag{6.9}$$

where ρ_n is the dipole density (graviphotons) measured in a system external to the distribution, and $\boldsymbol{u}$ represents the four-velocity. The four-potential is defined as:

$$A^\mu = \left(\frac{\phi}{c}, \mathbf{A}\right) \tag{6.10}$$

Considering the definition of the divergence of the vector potential **A** in Minkowski spacetime, which must be zero to satisfy the Lorenz condition for the invariance of a four-vector, the gauge operation introduced earlier thus establishes the invariance of the four-vector formed by the components of **A** and ϕ. It follows that the electrogravitational field is a gauge theory. If we consider the d'Alembertian, the electrogravitodynamic equations can be written very succinctly in the form [49]:

$$\Box A^\mu = \mu_{\mathrm{g}}\rho_n u^\mu = \mu_{\mathrm{g}}J^\mu \tag{6.11}$$

Derivatives of the components of the four-potential form a second-order tensor [50], generated by a polar vector (gravitational) **g** and an axial one (cogravitational) **K**. This results in the electrogravitational tensor.

$$F^{\mu\nu} = \partial^{\mu} A^{\nu} - \partial^{\nu} A^{\mu} \tag{6.12}$$

$$F^{\mu\nu} = \begin{pmatrix} 0 & \mathrm{g_x/c} & \mathrm{g_y/c} & \mathrm{g_z/c} \\ -\mathrm{g_x/c} & 0 & \mathrm{K_z} & -\mathrm{K_y} \\ -\mathrm{g_y/c} & -\mathrm{K_z} & 0 & \mathrm{K_x} \\ -\mathrm{g_z/c} & \mathrm{K_y} & -\mathrm{K_x} & 0 \end{pmatrix} \tag{6.13}$$

Finally, the stress-energy tensor [50], which describes the flow of electrogravitational energy and momentum in flat spacetime, is given by:

$$T^{\mu\nu} = -\frac{\mu_e c^4}{16\pi^2 GK}\left[F^{\mu\alpha}F^{\nu}{}_{\alpha} - \frac{1}{4}\eta^{\mu\nu}F_{\alpha\beta}T^{\alpha\beta}\right] \tag{6.14}$$

Where $F^{\mu\nu}$ is the electrogravitational tensor and $\eta_{\mu\nu}$ is the Minkowski metric tensor with signature $(- + + +)$. This tensor can be expressed in matrix form as:

$$T^{\mu\nu} = \frac{1}{c}\begin{bmatrix} \frac{c}{2}\left(\varepsilon_{\mathrm{g}}\mathrm{g}^2 + \frac{1}{\mu_{\mathrm{g}}}\mathrm{K}^2\right)\delta_{ij} & \mathrm{S}x & \mathrm{S}y & \mathrm{S}z \\ \mathrm{S}x & c\sigma_{xx} & c\sigma_{xy} & c\sigma_{xz} \\ \mathrm{S}y & c\sigma_{yx} & c\sigma_{yy} & c\sigma_{yz} \\ \mathrm{S}_z & c\sigma_{zx} & c\sigma_{zy} & c\sigma_{zz} \end{bmatrix} \tag{6.15}$$

where the S_i are the components of the Poynting vector (4.18), **g** and **K** are the gravitational and cogravitational fields given by equations (4.12-4.13), and σ_{ij} is the electrogravitational stress tensor, which takes the form:

$$\sigma_{ij} = \frac{\mu_e c^4}{16\pi^2 GK}\mathbf{g}_{\mathrm{i}}\mathbf{g}_{\mathrm{j}} + \frac{\mu_e c^6}{16\pi^2 GK}\mathbf{K}_{\mathrm{i}}\mathbf{K}_{\mathrm{j}} - \frac{1}{2}\frac{\mu_e c^4}{16\pi^2 GK}(\mathbf{g}^2 + c^2\mathbf{K}^2)\delta_{ij} \tag{6.16}$$

$$\sigma_{ij} = \varepsilon_{\mathrm{g}}\mathbf{g}_i\mathbf{g}_j + \frac{1}{\mu_{\mathrm{g}}}\mathbf{K}_i\mathbf{K}_j - \frac{1}{2}\left(\varepsilon_{\mathrm{g}}\mathbf{g}^2 + \frac{1}{\mu_{\mathrm{g}}}\mathbf{K}^2\right)\delta_{ij} \tag{6.17}$$

The dependence on conversion factors, and consequently on the fine-structure constant α, of the terms present in the equations presented so far, is implicit.

7. Quantization of Einstein's field Equation

7.1 Electrogravitational field equation

Einstein's field equation [6] describes the gravitational field through the curvature of spacetime caused by the presence of matter and energy (stress-energy tensor).

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu} \tag{7.1}$$

Here, $R_{\mu\nu}$ represents the Ricci curvature tensor, R is the scalar curvature, $g_{\mu\nu}$ is the metric tensor, $T_{\mu\nu}$ is the stress-energy tensor, and Λ is the cosmological constant. The term Λ was introduced by Einstein to allow for a static universe. However, observations by Hubble [23] in subsequent years showed that the universe was expanding, leading to the removal of the Λ term. In the current view [43], the cosmological constant plays the role of a large-scale antigravitational force (dark energy). However, the way this constant is introduced into the equation is incorrect. Firstly, we have seen that dark energy does not exist, and moreover, the universe is not expanding but contracting. Finally, the effects attributable to the cosmological constant manifest not only on a large scale but at every level of physical reality. Therefore, it is necessary to make each term depend on its respective conversion factor subscript (f), and hence on the fine structure constant α. This way, the cosmological constant Λ is spread across the entire field equation. Furthermore, within the electrogravitational theory, the proportionality constant is rearranged to highlight the constants K and μ_e, typical of electromagnetism.

$$R_{\mu\nu(f)} - \frac{1}{2} g_{\mu\nu(f)} R = \frac{32\pi^2 G_{(f)} K_{(f)}}{\mu_{e(f)} c_{(f)}^6} T_{\mu\nu(f)} \tag{7.2}$$

The left-hand side of the equation remains unchanged (even in its derivation [6]) compared to that developed by Einstein: all terms present are continuous quantities. The right-hand side, however, is quantized. Quantization of the left-hand side is achieved by introducing the length unit l_u from the tensor $T_{\mu\nu}$ (which can only take values between l_S and l_P), and placing its square in the numerator on the left-hand side, allowing for discretization of the elements $R_{\mu\nu}$ and $g_{\mu\nu}$. This results in a fully quantized (and dimensionless) version of the electrogravitational field equation. We proceed by substituting the expressions for the fields **g** and **K** (4.12-4.13) into the Poynting vector (4.18) and into the stress tensor (6.16-6.17), and then insert these into the stress-energy tensor (6.15). This ensures that the square of the length unit appears in the denominator of all components present in the stress-energy tensor.

$$l_{u(f)}^2 R_{\mu\nu(f)} - \frac{l_{u(f)}^2}{2} g_{\mu\nu(f)} R = \frac{32\pi^2 G_{(f)} K_{(f)}}{\mu_{e(f)} c_{(f)}^6} l_{u(f)}^2 T_{\mu\nu(f)} \tag{7.3}$$

This can then be expressed in a compact form, including the proportionality constant within the stress-energy tensor:

$$l_{u(f)}^2 G_{\mu\nu(f)} = l_{u(f)}^2 \bar{T}_{\mu\nu(f)} \tag{7.4}$$

Here, $1/l_{u(f)}^2$ represents the "quantum of curvature", expressed in terms of the smallest measurable length, $G_{\mu\nu(f)}$ is the Einstein tensor, and $\bar{T}_{\mu\nu(f)}$ is the stress-energy tensor, which includes the proportionality constant. In the case where we wish to quantize the field equation based on the radius of the electric charge of the graviphoton, the lengths l_S/l_P must be divided by 2, since the length unit l_S/l_P represents the binding distance between the two charges of the graviphoton. Additionally, it is possible to discretize the terms $R_{\mu\nu}$ and $g_{\mu\nu}$ based on the wavelength λ of the electrogravitational wave. In this scenario, since the proportionality constant includes the speed of light c^6 in the denominator, it suffices to substitute $c^2 = \lambda^2 v^2$, and then bring the term λ^2 to the denominator on the left-hand side. The solutions [51] of Einstein's field equation are represented by spacetime metrics. In the electrogravitational case, since the field equation is quantized, the solutions are also found to be quantized. These solutions enable the treatment of phenomena from both relativistic and quantum-mechanical perspectives.

7.2 Gravitoelectric field equation

In Chapter 4, we saw that the electrogravitational equations (4.8-4.11) can be inverted to express them in terms of the electric and magnetic fields (4.8b-4.11b; see Appendix). Similarly, in the case of gravitoelectric fields, it is possible to formulate the equations in terms of scalar and vector potentials. These are derived by inserting

$$q_i = z_i q_e = z_i \sqrt{\frac{m_S c^2 l_S}{K}} \qquad (z_i \in \mathbb{Z}) \tag{3.4b}$$

(3.4b) into the electrodynamic equations. Likewise, it is possible to define a gravitoelectric-type stress-energy tensor. In this case, the quantization of the field equation is achieved by bringing the square of the length unit to the denominator of the various members of the stress-energy tensor (until achieving a situation similar to the previous one), followed by the same procedure recommended in Section 7.1. The same approach applies to other types of quantization previously described.

8. Elementary particles

8.1 Introduction

Throughout history, our understanding of the structure of matter has undergone a gradual evolution. Around 450 BC, the philosopher Empedocles proposed the hypothesis that the world was composed of four fundamental elements: fire, earth, water, and air. He suggested that by combining these four elements, it was possible to generate every type of substance. Almost simultaneously, Democritus proposed the idea that matter was instead made up of indivisible particles which he called atoms. The existence of atoms was confirmed in the early 1900s [7]. With this discovery, it seemed that the mystery of matter had finally been solved. However, subsequent experiments revealed that atoms themselves had an internal structure consisting of protons, neutrons, and electrons. It was later discovered that even protons and neutrons could be further divided. Gradually, numerous other particles were discovered, especially through the use of accelerators. These particles were then classified into elementary and non-elementary based on how they interacted with light. This led to the formulation of what we now know as the Standard Model [52]. As currently formulated, however, this theory is incomplete. Firstly, it describes only three of the four fundamental interactions separately: electromagnetic, weak, and strong nuclear forces. Within it are classified particles such as quarks and gluons, which, as we will see, are not elementary. Furthermore, the photon and the graviton represent the same particle, the graviphoton: thus, it is possible to include gravitational interaction and general relativity in the Standard Model. Additionally, elementary electric charge must also be included in this model, as it is a fundamental unit from which all other particles derive. We also know that the Standard Model fails to predict certain physical phenomena, including baryon asymmetry: in fact, on average, at the elementary level, there is as much matter as antimatter (the number of negatively charged elementary electric charges is exactly equal to the number of positively charged elementary electric charges. The same applies to elementary particles). Baryon asymmetry reduces to positional asymmetry (mutual arrangement of particles). Furthermore, the Standard Model does not account for the accelerated expansion (contraction) of the universe (matter), as it does not propose any particle for dark matter: as we have seen, such a particle cannot exist simply because dark matter does not exist. Finally, it does not provide any explanation as to why elementary particles are exactly those and why they have those characteristics.

8.2 The internal structure of elementary particles

The electrogravitational theory tells us that the graviphoton $g\gamma^0$ is formed by the union of two elementary electric charges of opposite sign. Therefore, since all matter can be converted into graviphotons, everything that exists in the universe is composed of elementary electric charges. In this way, analogous to atoms, which can be traced back to their progenitor, the hydrogen atom, elementary particles can be traced back to the elementary electric charge $q_e^{-/+}$. Inside atoms, electrons are distributed in orbitals. The s orbitals have a spherical shape and are isotropically distributed around the atomic nucleus. In contrast, p orbitals have a dumbbell shape and have three distinct orientations along the coordinate axes. There are also d and f orbitals, although at the elementary level they are not important (?). The difference in shape in the electronic cloud of s and p orbitals is crucial for understanding chemical interactions (bonds). Each s orbital and each p orbital can contain a maximum of 2 electrons, which must necessarily have opposite spins (Pauli exclusion principle). In the case of elementary particles, we find ourselves in a similar scenario (see Paragraph 8.3). Firstly, they do not possess a nucleus (the role of the nucleus is assumed by the charge center). Another distinction lies in the fact that, instead of hosting electrons, the orbitals are filled with elementary electric charges $q_e^{-/+}$. Furthermore, considering that filling occurs at the elementary level, we have only 10 available slots (?), given by the $1s$, $1p$, and $2s$ orbitals (with the $1p$ level having lower energy than $2s$). In this context, a principle similar to exclusion applies to the sign of charges (and not to spin): in the same orbital, only elementary charges (bosons) of opposite sign (-/+) can coexist. If an orbital is fully filled, we have a neutral elementary particle; if there is an unpaired charge, we have a particle (-) or an antiparticle (+), respectively. With only 10 slots available, there are 10 possible elementary particles (?), 4 bosons and 6 leptons. Quarks are not elementary particles, but "overlapped states" (quasiparticles). The same applies to gluons. The Higgs boson represents the particle obtained from the hybridization of the $1p$ and $2s$ orbitals of the Z^0 boson (from which it derives). The Higgs boson, being rotationally invariant, has Spin 0. Filling the orbitals of elementary particles leads to a difference of a single electric charge between one particle and the next. Therefore, we can assign a parameter analogous to atomic number to particles (elementary and non-elementary), the charge number (n_c). This parameter tells us how many charges a particle is composed of, regardless of their sign. The elementary electric charge $q_e^{-/+}$ will have $(n_c = 1)$, the graviphoton $g\gamma^0$ $(n_c = 2)$, the electron $e^{-/+}$ $(n_c = 3)$, the electron neutrino ν_e $(n_c = 4)$, the muon $\mu^{-/+}$ $(n_c = 5)$, the muon neutrino ν_μ $(n_c = 6)$, the tauon $\tau^{-/+}$ $(n_c = 7)$, and the tau neutrino ν_τ $(n_c = 8)$. The $W^{-/+}$ $(n_c = 9)$ and Z^0 $(n_c = 10)$. The Higgs boson, deriving from the Z^0 boson, also has $(n_c = 10)$. For gluons and quarks, we will see later how to calculate their charge numbers (we can anticipate that the charge numbers of quarks are fractional).

8.3 Elementary orbitals

In 1924, Louis de Broglie proposed that each particle could be associated with a wave. This work [10] inspired Schrödinger in formulating his equation, which, in its time-independent form, can be derived directly from the wave equation. Taking into account equation (5.6), time-independent Schrödinger equation is expressed as:

$$-\frac{Z_0^2 q_e^4}{32\pi^2\alpha^2 m}\nabla^2\psi(\boldsymbol{r}) + V(\boldsymbol{r})\psi(\boldsymbol{r}) = E\psi(\boldsymbol{r}) \tag{8.1}$$

In the case of an atom, among the solutions of the Schrödinger equation there are the atomic orbitals. These tell me in which region of space an electron is most likely to be found (the square of the wave function represents the probability density of finding an electron in a particular position). Similarly, when we apply this equation to elementary particles, among the solutions we have elementary orbitals. These tell me in which region of space an elementary electric charge is most likely to be found. Thus, akin to atomic orbitals, elementary orbitals can also be defined. At the elementary level, the electric potential $V(\boldsymbol{r})$ is determined by the electric charges relative to the charge center (elementary particles do not have a nucleus). The number and type of elementary orbitals can be deduced by solving the Schrödinger equation. Here too, we have s and p type orbitals, with the $1p$ level having lower energy than the $2s$. Elementary d and f orbitals are not significant (?). Analogous to atoms, we can define a ***principal quantum number*** n, which defines the energy, extent, and number of nodes of the orbital, an ***azimuthal quantum number*** l, which is linked to the orbital symmetry, a ***magnetic quantum number*** m_l, determining the type of node, its orientation, and the multiplicity of orbitals, and a ***spin quantum number*** m_s, which can only take two values, ± 1, because elementary electric charges are bosons. According to the Pauli exclusion principle, each atomic orbital can contain at most two electrons with opposite spins, as they are fermions. In the elementary case, we have a similar principle, which applies to the sign of charges (bosons). This tells me that each elementary orbital can contain at most two elementary electric charges of opposite sign. At the elementary level, the Aufbau principle also applies: orbitals are filled starting from those with the lowest energy (ground state), and proceeding towards those with higher energy; if there are "degenerate" orbitals (multiple eigenstates for a single eigenvalue, such as the three p orbitals), the Hund's rule does not apply; according to this rule, in the atomic case, electrons preferentially occupy orbitals to maximize the number of unpaired electrons. The arrangement of elementary electric charges in the orbitals of elementary particles constitutes their electronic configuration, which determines the geometry and interaction capability (type of force) of the elementary particle.

8.4 Elementary particles

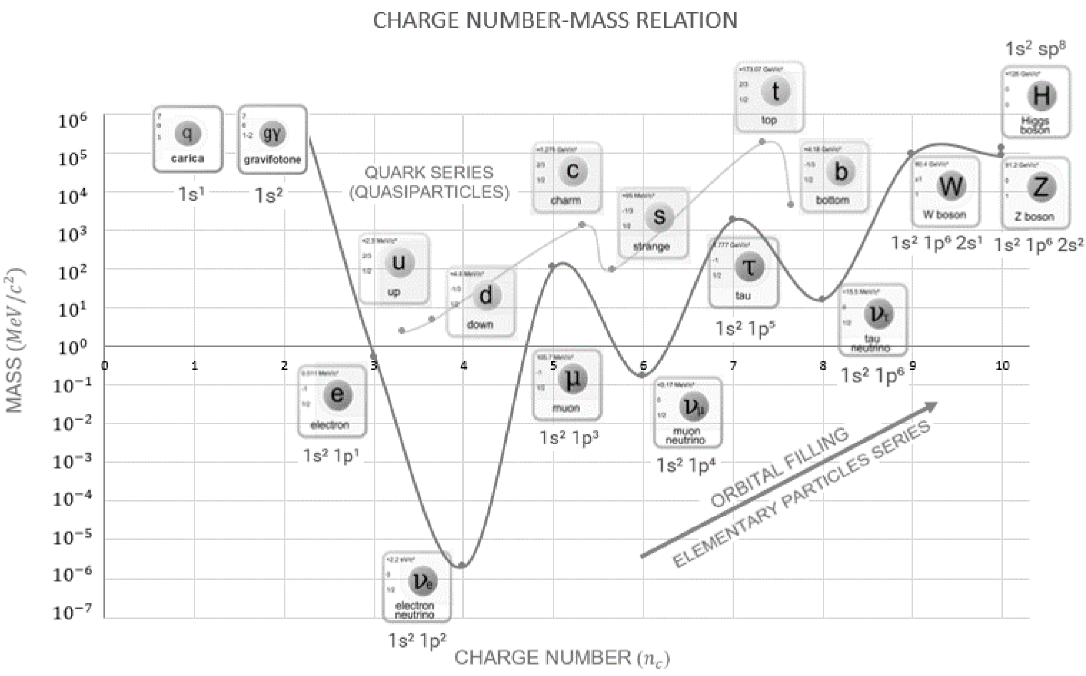
Bosons are *elementary particles* whose outer shell is formed by s-type (spherical) orbitals. The spherical shape of the orbital gives bosons integer spin. These characteristics allow them to adhere to Bose-Einstein statistics and to interact more easily with other particles: they are carriers of the four fundamental forces. In the case of force interactions, bosons act as carriers of charges and masses, binding other particles together. There are 4 bosons: the free electric charge $q_e^{-/+}$ ($1s^1$), the graviphoton $g\gamma^0$ ($1s^2$), the $W^{-/+}$ ($1s^2 1p^6 2s^1$), and the Z^0 ($1s^2 1p^6 2s^2$). If the s orbital is fully occupied, we have a neutral boson; otherwise, a charged one (whether it is a particle or antiparticle depends on the sign of the unpaired charge). *Leptons* are *elementary particles* whose outer shell is composed of p-type (double-lobed) orbitals. The elongated shape of the orbital gives leptons half-integer spin. These characteristics allow them to adhere to Fermi-Dirac statistics. There are 6 leptons: the electron $e^{-/+}$ ($1s^2\ 1p^1$), the electron neutrino ν_e ($1s^2\ 1p^2$), the muon $\mu^{-/+}$ ($1s^2\ 1p^3$), the muon neutrino ν_τ ($1s^2\ 1p^4$), the tauon $\tau^{-/+}$ ($1s^2\ 1p^5$), and the tau neutrino ν_τ ($1s^2\ 1p^6$). If the orbital is fully occupied, we have a neutral lepton; otherwise, a charged one. Complete filling of a p orbital gives neutrinos a strong directionality, making them less likely to interact with other particles. The nature of the charged lepton depends on the sign of the unpaired charge present in the orbital (resulting in a particle if negative or an antiparticle if positive). Leptons also act as mediators: the electron mediates in bonds and chemical reactions by carrying the bonding force. The *Higgs boson* corresponds to the *elementary particle* obtained from the Z^0 boson through the hybridization of the 3 p orbitals with the 2s orbital. To hybridize the Z^0 boson, energy must be supplied to overcome the energy barrier required to mix the orbitals. The Higgs particle has a body-centered cubic configuration, with the center occupied by the $1s$ orbital. In the outer shell, $sp3$ hybridization gives the particle a symmetry that is invariant under rotation in a 3+1-dimensional space (Spin 0). In the Higgs boson, all 8 states, the 8 vertices of the cubic elementary cell, are occupied, making it physically impossible (?) to occupy others to “create” additional elementary particles. Quarks are quasiparticles. In fact, breaking down a proton or neutron into three parts (asymmetrically) is like breaking down a cyclopropene molecule into three parts (a molecule with asymmetric electron sharing) and saying that the uninvolved carbon atom (which therefore has a relatively lower charge density) is different from the other two carbon atoms. This is true only in the cyclopropene molecule. The same applies to the elementary particles constituting protons and neutrons (leptons with $n_c = 3$). Therefore, to continue using the rules of Quantum Chromodynamics (QCD), we must redefine both the concept of quark and gluon. Quarks are simply leptons that share a free elementary electric charge (quantum singularity). Thus, the free electric charge is shared (delocalized) among the leptons (3 in the case of protons and neutrons). The *up quark* is that quasiparticle (overlapping state) that spends $2/3$ of its existence as a free lepton, a free positron ($n_c = 3$), and $1/3$ bound to the delocalized charge, and thus as a gluon ($n_c = 3 + 1$). Thus, the average charge of the up quark is $+2/3$ and its average charge number ($n_c = 3.3\overline{3}$). The delocalized charge does not contribute (**) to the spin of the quasiparticle, which therefore is that of the positron (Spin 1/2). The *down quark* is that quasiparticle that spends $1/3$ of its existence as a free lepton, a free electron ($n_c = 3$), and $2/3$ bound to the delocalized charge, and thus as a gluon ($n_c = 3 + 1$). Thus, its average charge is $-1/3$ and its average charge number ($n_c = 3.6\overline{6}$). The delocalized charge does not contribute (**) to the spin of the quasiparticle, which therefore is that of the electron (Spin 1/2). The *charm quark* is that quasiparticle that spends $2/3$ of its existence as a lepton, a free muon μ^+ ($n_c = 5$), and $1/3$ bound to the delocalized charge, and thus as a gluon ($n_c = 5 + 1$). Thus, the average charge of the quark is $+2/3$ and its average charge number ($n_c = 5.3\overline{3}$). The delocalized charge does not contribute (**) to the spin of the quasiparticle, which therefore is that of the muon μ^+ (Spin 1/2). The *strange quark* is that quasiparticle that spends $1/3$ of its existence as a lepton, a free muon μ^- ($n_c = 5$), and $2/3$ bound to the delocalized charge, and thus as a gluon ($n_c = 5 + 1$). Thus, its average charge is $-1/3$ and its average charge number ($n_c = 5.6\overline{6}$). The delocalized charge does not contribute (**) to the spin of the quasiparticle, which therefore is that of the muon μ^- (Spin 1/2). The *top quark* is that quasiparticle that spends $2/3$ of its existence as a lepton, a free tauon τ^+ ($n_c = 7$), and $1/3$ bound to the delocalized charge, and thus as a gluon ($n_c = 7 + 1$). Thus, the average charge of the quark is $+2/3$ and its average charge number ($n_c = 7.3\overline{3}$). The delocalized charge does not contribute (**) to the spin of the quasiparticle, which therefore is that of the tauon τ^+ (Spin 1/2). The *bottom quark* is that quasiparticle that spends $1/3$ of its existence as a lepton, a free tauon τ^- ($n_c = 7$), and $2/3$ bound to the delocalized charge, and thus as a gluon ($n_c = 7 + 1$). Thus, its average charge is $-1/3$ and its average charge number ($n_c = 7.6\overline{6}$). The delocalized charge does not contribute (**) to the spin of the quasiparticle, which therefore is that of the tauon τ^- (Spin 1/2). The gluon represents a momentarily bound state (which we can consider analogous to what delocalized electrons form in some organic molecules), of a lepton with a delocalized elementary electric charge (quantum singularity). Its charge number is ($n_{c\,(gluone)} = n_{c\,(leptone)} + 1$), therefore that of the starting charged lepton, to which an additional unit given by the elementary charge must be added. There are three types of gluons: those formed from the electron $e^{-/+}$ ($n_c = 3 + 1$), those formed from the muon $\mu^{-/+}$ ($n_c = 5 + 1$), and those formed from the tauon $\tau^{-/+}$ ($n_c = 7 + 1$). Its charge is always zero, regardless of the type of gluon. Its spin is always unitary, because it is that of the charge (**).

8.5 Center of charge and quantum singularity

We have seen that elementary particles do not have a true nucleus, and this role is taken by the charge center, located at the center of the spherical $1s$ orbital. In the case of the elementary electric charge, the charge center coincides with the charge itself (each elementary electric charge contracts at speeds greater than that of light). The leptons that make up subatomic particles (protons and neutrons), in turn composed of elementary electric charges, share a central singularity (free elementary electric charge), arranged like celestial bodies in a galaxy, with the difference that, in the case of the quantum singularity, the charges always arrange themselves on the horizon of the singularity. In fact, the rotational velocity of leptons around the singularity is lower (for an external observer) by a factor of about 3.42 per component ($1/\alpha \approx 137$ in total), and their mass is higher by a factor of about 40, because the force that holds them together increases with distance (it can be said that they are subject to the strong force). Another obvious difference is that in galaxies, celestial bodies are bound to each other through the force of gravitational attraction, while the constituents of particles are bound by electric forces. A component that increases with distance is present in both cases (strong or singularity force), due respectively to the black hole and the free elementary electric charge (a black hole is precisely an unshielded, "naked" elementary charge). As we will see, the mass of the proton, much greater than that of the electron, is due to the fact that the 3 leptons (in the form of quarks) constituting the subatomic particle each fall into the cone of influence of the adjacent lepton/quark, (which does not happen in the case of the 3 charges of the electron as they rotate around their charge center). In this way, the leptons constituting the proton will appear more massive to an external observer.

8.6 Charge number-mass relationship

To describe an atom, two characteristics are fundamental, its weight and its atomic number. The relationship between atomic number and atomic weight shows significant linearity. In the case of elementary particles, the situation is a bit more complex. As the charge number increases, up to the Higgs boson, an exponential (oscillating) increase in mass is observed. Two main trends can be identified: one for neutral particles (the 3 neutrinos, the Z^0 boson, and the Higgs boson) with lower mass/energy, and another for charged particles (the 3 charged leptons and the $W^{-/+}$ boson). The (gravitational) mass of the graviphoton varies depending on its position, however this mass cannot be measured (it is null), as the graviphoton cannot exchange other graviphotons except itself. A complete description is in the appendix.



9. Subatomic particles

9.1 Mass ratios between proton, electron and neutron

Quantum Chromodynamics (QCD) tells us that the proton consists of 2 up quarks and 1 down quark. The up quark has a charge number ($n_c = 3.3\overline{3}$), while the down quark has a charge number ($n_c = 3.6\overline{6}$). Remembering that the up quark is the quasi-particle that spends 2/3 of its existence as a positron and 1/3 as a gluon (3+1), while the down quark is the quasi-particle that spends 1/3 of its existence as an electron and 2/3 as a gluon (3+1); at this stage, we can overlook the mechanism that causes the charge to bind with the leptons. The average charge number of the quarks is calculated by averaging the charge numbers of the individual quarks in the proton:

$$\bar{n}_c = \left(\frac{3.3\overline{3} + 3.3\overline{3} + 3.6\overline{6}}{3}\right) \approx 3.44 \qquad (9.1)$$

The ratio between the average charge number of one of the quasi-particles in the proton and that of the electron is:

$$R = \frac{\bar{n}_c}{n_c} \approx \frac{3.44}{3} \approx 1.1466 \qquad (9.2)$$

This means that each quasi-particle constituting the proton, in terms of charges, is worth approximately 1.1466 times that of the electron. Finally, the ratio between the number of constituents of the two particles is:

$$N = \frac{constituents\ of\ proton}{constituents\ of\ electron} = \frac{3}{1} = 3 \qquad (9.3)$$

The mass difference between the two subatomic particles arises from the fact that the 3 leptons (in the form of up/down quarks) constituting the proton, during rotation, each fall into the cone of influence of the adjacent lepton (quark), which does not happen in the case of the 3 charges of the electron as they rotate around their charge center. Therefore, when an external observer makes measurements, as in the case of galaxies, they will obtain values that are biased by the effects related to singularities, effects that are always maximized. Considering this, we can proceed to calculate the ratio between the mass of the proton and that of the electron. We need to consider (as in the case of galaxies) the conversion factor for the force and apply it to the three quarks constituting the proton. The ratio (m_P/m_e) can be calculated in at least two ways. The presented method takes into account that only one quark of the proton interacts at a time. The ratio (m_P/m_e) is calculated using the following formula:

$$\frac{m_P}{m_e} = R \cdot \left(\frac{1}{f[\boldsymbol{F}]}\right)^N = R \cdot \left(\frac{1}{\sqrt{\alpha}}\right)^N \approx 1.1466 \cdot (11.7)^3 \approx 1836 \qquad (9.4)$$

By inserting the mass of the electron into the equation, it is possible to calculate the mass of the proton (and viceversa). The same applies to the neutron. The neutron consists of 2 down quarks and 1 up quark. The average charge number of the quarks constituting the neutron is calculated by averaging the charge numbers of the quarks:

$$\bar{n}_c = \left(\frac{3.3\bar{3} + 3.6\bar{6} + 3.6\bar{6}}{3}\right) \approx 3.55 \tag{9.5}$$

The ratio between the charge number of one of the quasi-particles constituting the neutron and that of the electron is:

$$R = \frac{\bar{n}_c}{n_c} \approx \frac{3.55}{3} \approx 1.185 \tag{9.6}$$

This means that each quasi-particle constituting the neutron, in terms of charges, is worth 1.185 times that of the electron. Since the ratio between the number of constituents of the two particles is also $N = 3$ in this case, applying the conversion factor for the force to each of the three quarks constituting the neutron, we obtain:

$$\frac{m_N}{m_e} = R \cdot \left(\frac{1}{f[\boldsymbol{F}]}\right)^N = R \cdot \left(\frac{1}{\sqrt{\alpha}}\right)^N \approx 1.185 \cdot (11.7)^3 \approx 1898 \tag{9.7}$$

Finally, we can calculate the mass ratio between the neutron and the proton.

$$\frac{m_N}{m_P} \approx \frac{1898}{1836} \approx 1.034 \tag{9.8}$$

This does not correspond to what is observed experimentally [53]. In nature, the mass of the neutron differs by only 0.1% from that of the proton, while according to calculations, it should be 3.4%. This discrepancy could be attributed to the presence of additional delocalized charge in the neutron, which generates greater attraction between the quarks, bringing them closer to the central (delocalized) singularity.

9.2 HYDROGEN ATOM

The difference between what is expected to be measured and what is actually observed [30] can be explained in this way. The charges constituting the electron orbit around its own charge center. Additionally, when the electron is bound to the proton (in the hydrogen atom), it also rotates around the singularity of the proton. Therefore, the electron will have a lower velocity than theoretically predicted (≈ 3.42 for each component). It will also be closer to the nucleus. In fact, the orbit of the electron will be smaller by a factor of ≈ 3.42 for each component, a situation opposite to what occurs in the universe, where the measured R_{uI} is larger than the predicted radius R_{uT}.

10. The forces

10.1 THE MEANING OF FORCES

From a quantum perspective, force is nothing more than the effect that occurs as a result of the exchange of particles, called mediators [52]. This process is analogous to monetary exchange. Since all particles (coins) can be exchanged, all are carriers of force. Particles interact with each other in two ways: electrically and gravitationally, although each in a different manner. At the elementary level, depending on the particle carrying it, force can be divided into bosonic force (mediated by bosons) and leptonic force (mediated by leptons). These can then be further subdivided, based on the particle involved in the exchange, into strong force or singularity force $q^{-/+}$, electrogravitational force $g\gamma^0$, weak force $W^{-/+}$, Z^0, leptonic forces $e^{-/+}$, $\mu^{-/+}$, $\tau^{-/+}$, and neutrino forces ν_e, ν_μ, ν_τ. The ***strong force or singularity force*** (free electric charge $q^{-/+}$) is the force that holds together the constituents of subatomic particles and operates whenever there is a singularity. It is mediated by free electric charge (spacetime itself). Contrary to popular belief, it also operates on a large scale, as in the case of galaxies and the entire universe, where it causes all those effects attributed to dark energy and matter. This force increases with distance from the singularity, as predicted by conversion factors. Its coupling constant is approximately 137 times greater than that of the electromagnetic force. This is easily explainable, as in the case of mutual interaction between elementary particles, the force conversion factor is $f^{-2}[\boldsymbol{F}] \approx 11.7^2$. The ***electrogravitational force*** (*graviphoton* $g\gamma^0$) represents the force responsible for the manifestation of electrical, magnetic, and gravitational phenomena. The ***weak force*** (*bosons* $W^{-/+}, Z^0$) is responsible for beta decay processes in atomic nuclei. The ***leptonic forces*** (*electron* $e^{-/+}$, *muon* $\mu^{-/+}$, *tauon* $\tau^{-/+}$). The binding force (*electron* $e^{-/+}$) is the force that binds atoms in molecules and modulates chemical reactions. At a higher level (molecular), this constitutes the analogue of the strong force. Regarding the other leptonic forces (*muon* $\mu^{-/+}$, *tauon* $\tau^{-/+}$), muons and tauons, due to their high mass, have a shorter average lifespan compared to electrons. In ordinary contexts, these particles are not involved; however, at very high energies such as in colliders, they can replace electrons in some electronuclear reactions. ***Neutrino forces*** (neutrinos ν_e, ν_μ, ν_τ). Due to the directional nature of p orbitals, these particles can pass through large amounts of matter without interacting. This characteristic makes them particularly interesting for the study of astrophysical phenomena and for experiments requiring the detection of particles from very distant sources. ***Gravitational force*** (*all particles*). Because all particles (elementary and non-elementary) are composed of elementary electric charges, which themselves represent a deformation (-/+) of spacetime, this force acts on all particles, both through being a deformation of spacetime and through the exchange of graviphotons.

11. The Multiverse

11.1 The black-hole universe

We have identified four impassable limits (horizons). These separate the observable universe (each observer has their own observable universe) from those regions of spacetime unreachable by light, and therefore impenetrable (singularities): our observable universe, black holes, and quantum singularities (elementary electric charges) are entities of the same kind. Consequently, there must be some connection between them. In fact, our universe is the progenitor of all the black holes present within it. Quantum singularities (elementary electric charges), on the other hand, represent the "embryos" from which, under certain conditions (critical mass/energy sufficient to break the bond between the two elementary electric charges of the graviphoton), new black holes (and thus new universes) can form. This thesis is supported by some interesting analogies. The first we have already seen: in a black hole, the event horizon represents the point beyond which there is no causal relationship with the interior. The same situation occurs with quantum singularities and, conversely, with the cosmic horizon. The second observation is this: the gravitational attraction force generated by the mass of the entire universe (at a distance equal to R_{uI} if we take into account dark matter, or R_{uT} if we consider only ordinary matter) is of the same order of magnitude as the Planck force c^4/G, which is the force required to create a black hole and the force that holds together, in flat spacetime, the two charges of the graviphoton: when the bond between the electric charges is "broken," the negative charge will form a black hole, while the positive one (white hole) will distribute throughout the entire universe, increasing its energy (mass). This explains both the positional asymmetry of elementary particles in atoms (positrons at the center) and the energy of the vacuum. Therefore, our universe is part of a black hole formed about 13.6 billion years ago in a higher universe through the gravitational collapse of a sufficiently massive star there. In this perspective, the cosmic microwave background radiation represents what remains of the formation of our universe-black hole. The redshift of the cosmic microwave background radiation is related to the contraction (still ongoing) of matter and, therefore, of the ruler with which measurements are made. Furthermore, what is commonly referred to as primordial expansion is actually a phase of violent contraction, resulting from the gravitational collapse of the star from which our black hole-universe originated.

11.2 The repeated gravitational collapses multiverse

There has always been debate about what the ultimate fate of the universe could be [26]. Eternal inflation, proposed by Alan Guth, represents a cosmological model derived from extending the Big Bang theory. This contrasts with other cosmological theories, particularly the cyclic model, which predicts a repeated series of expansions and contractions. The theory of eternal inflation includes the multiverse variant proposed by Andrei Linde (bubble theory). In Linde's multiverse, universes expand within each other. Each universe is confined within its bubble in eternal inflation. In this scenario, our observable universe represents nothing more than a tiny region of existence, which may have had a beginning, or perhaps not. In Linde's theory, each of these universes has different parameters and constants, and only a few have values that have allowed for the development of life. However, the fine-tuning of the physical laws of our universe (fine-tuned universe) could also be the result of intelligent design (designed universe; this represents one of the main paradigms of digitalist physics), and therefore life might be expected in each of the bubbles. The concept of a bubble universe involves the formation of universes derived from a “parent universe”. The “child” universes would be generated from nuclei, “embryos” or “cosmic eggs”, pre-existing at the Planck scale (which, as we have seen, are quantum singularities/elementary electric charges). Our idea of the multiverse differs from Linde's bubble theory, as instead of being based on an infinite series of expansions, it is based on a repeated series of gravitational collapses (Matryoshka Multiverse). Moreover, the complexity of life cannot be something random, but designed, and therefore expected in every universe. We know that in a star, when the nuclear fusion process exhausts its fuel and the mass is sufficiently high, it collapses upon itself, giving rise to a black hole, and thus to a new universe [54], which is nothing but a “naked” elementary electric charge (unshielded). From this, it follows that all black hole-universes, to form, must reach a minimum mass limit (in this view, white dwarfs represent failed universes). Our universe exists within a larger universe and contains, in turn, other universes: it is very likely that some of the most massive black holes in our universe harbor other black holes inside them, and thus other universes, hence the name Matryoshka Multiverse. In this perspective, our universe represents only one of the many levels (realms) that make up the multiverse, all separated by horizons (limits), which are simultaneously event horizons (for an external observer) and cosmological horizons (for an internal observer).

11.3 THE ETERNAL RETURN

The view of the multiverse as a series of repeated gravitational collapses (a Matrioshka) connects to the concept of "eternal return." This concept states that all events recur in time after a certain period (return period), in a cyclical manner, like seasons. The Stoics believed that the universe was periodically destroyed and rebuilt, and that each universe was a similar version of the previous one. If the universe (multiverse) is infinite in duration but not in material content, then all matter must pass through a finite number of combinations, and every series of combinations, especially the most probable ones, must eventually repeat (Ouroboros). This can be related (?) to Poincaré's recurrence theorem, which states that dynamical systems can return infinitely close to their original state, and if these systems are discrete, there is a possibility that they return exactly to their starting state. The theorem, first proposed by Henri Poincaré in 1890, forms the basis of ergodic theory today. This theorem also applies in the case of systems as large as a galaxy or the entire universe.

12. Matrix (and Simulation?)

12.1 Introduction

During the Industrial Revolution, Joseph Marie Jacquard developed a device in Lyon capable of significantly accelerating the silk weaving process. This device, known as the Jacquard loom, demonstrated that information could be manipulated and managed mechanically. The secret of this invention lay in a simple punched card, which controlled the lifting and lowering of the loom to recreate the desired pattern in the fabric. This invention showed that it was possible to capture the essence of something and represent it in a different form, much like writing captures spoken language and transforms it into symbols. Jacquard had demonstrated that with just two symbols, a hole or an empty space, it was possible to capture the information of any image. Translating information into symbols represented an idea of extraordinary power, yet their methods of transmission and communication were still constrained by the speed at which physical objects could be transported. This limitation was overcome when electricity was discovered for information transfer. In this regard, in 1840, Samuel Morse developed the telegraph, a device capable of sending a sequence of short and long pulses of electric current, which when combined appropriately, could represent all the letters of the alphabet. Since Morse's time, it was realized that information was not just about communicating a message but was a concept of broader scope. This all began to emerge thanks to a problem posed by the Scottish physicist James Clerk Maxwell, who was among the first to understand that heat was linked to the movement of molecules. Maxwell imagined a tiny demon perched on a box with such acute vision that it could precisely observe the movement of all the molecules inside. The demon controls a door that divides the box in half. Every time it sees a fast-moving molecule approaching the door from the right, it opens it to allow passage to the left. Likewise, when it sees a slow-moving molecule approaching the door from the left, it opens it to allow passage to the right. Over time, all the fast-moving molecules will accumulate on the left side of the box, while all the slow-moving molecules will be on the right. Maxwell's demon seemed to suggest that simply by knowing what happens inside the box, it would be possible to make one half hotter and the other colder without using any energy, creating order from disorder. Scientists intuitively felt that something was amiss, but it took more than a century to resolve this puzzle. It required the development of what we now know as "information theory". One of its pioneers was Claude Shannon. In his publications, Shannon demonstrated that information is closely tied to the surprise element of a message. Information becomes news when it is unexpected. If today's news were to replicate yesterday's news, there would be nothing new, and its informational content would be zero. Shannon also developed a method to quantify the information contained in a message. He realized that the binary digit (bit), zero or one, could be used as a fundamental unit since any message could be translated into a sequence of zeros and ones. The binary digit (bit) thus represents the atom of information, the smallest unit sufficient to communicate anything. Everything, whether sounds, images, or texts, can be digitized and transmitted in the form of bits using a system capable of assuming at least two states. In fact, any system with two states, such as a coin, contains a bit of information. Through Shannon's discoveries, it was finally possible to provide an answer to Maxwell's puzzle. When the demon identifies a molecule, it must store its information. However, since its memory is finite, there will come a time when it must erase them (to make room for new ones), thus increasing, in an irreversible process, the entropy of the universe. This erasure consumes energy. What was discovered is that there is a minimum amount of energy, known as Landauer's limit, required to erase one bit of information. This demonstrates that energy and information are two physically connected concepts. Indeed, it has always been apparent that the creation of physical order, such as the construction of architectural or invisible digital structures, incurs an energy cost. Information obeys physical laws, like any other thing present in the universe [*].

12.2 THE INFORMATIONAL UNIVERSE

Despite the abstract nature of information, for it to exist, it must be embodied in a physical system. Information must be "contained" by something, whether it's a stone slab, a book, a CD, or any other medium. This raises the question of whether there exists a fundamental level at which information can be encoded, the level of the fundamental "0s" and "1s". This can only be the spacetime itself (electrogravitational field). We have seen how the smallest fluctuation of spacetime corresponds to the elementary electric charge, which therefore represents the "quantum of curvature", with the charge sign corresponding to the sign of the disturbance (if we consider spacetime as a vast ocean, elementary electric charges can be seen as bubbles/anti-bubbles that emerge and dissolve within it; elementary and non-elementary particles are therefore clusters of bubbles/anti-bubbles). The electrogravitational field can be assigned the value "0" where it is undisturbed, and the value "1" where there is an elementary electric charge present. The entire reality is thus an enormous dynamic matrix (binary or ternary, depending on whether the sign of the charges is considered or not). The points of the field are akin to the “pixels” of a screen, with the ability to be either on or off. The total curvature of the field (mass) is determined by the sum total of elementary charges, regardless of their sign, hence by all those “on” points.

12.3 LAW OF CONSERVATION OF INFORMATION

We know that electric charge is a conserved quantity, which implies that whenever there is a positive-sign fluctuation in the spacetime fabric, there must simultaneously be an equivalent fluctuation with opposite sign. Therefore, information, like any other physical quantity, is conserved. We can thus formulate the following equation:

$$n(1) + n(-1) = 0 \tag{12.1}$$

For $(n \in \mathbb{N}) = 1$, this reduces to the constitutive relation of the gravifoton, represented by the string (-1;1). Moreover, since the bit "1" corresponds to the elementary electric charge, which is related to mass and energy, we can formulate a general law of conservation. Remembering that $1 = e^{-i\pi}$ and substituting $\pi = \alpha h_P c/2Kq_e^2$, we can define the "1" bit through the complex exponential; a similar relation holds for the negative bit "-1". We obtain the general relationship, which involves the fine-structure constant α, Planck's constant h_P, the speed of light c, the 2 (principle of duality), Coulomb's constant K, and the elementary electric charge q_e.

$$n\, e^{-i\frac{\alpha h_P c}{2Kq_e^2}} + n\, e^{i\frac{\alpha h_P c}{2Kq_e^2}} = 0 \tag{12.2}$$

When $n = 1$, this reduces to Euler's identity $e^{i\frac{\alpha h_P c}{2Kq_e^2}} + 1 = e^{i\pi} + 1 = 0$. The dependence on the conversion factors of the terms in the equation is implicit.

12.4 Particles as numerical strings

Within particles, elementary electric charges are distributed so that within the same orbital there are at most two charges (Pauli-like exclusion principle), with opposite signs (-1;1). Since each elementary electric charge corresponds to a bit (positive or negative), this implies that every particle, particularly elementary ones, can be represented by a numerical string. Therefore, everything that exists can be reduced to atoms, atoms to subatomic particles, and subatomic particles in turn to elementary electric charges, which ultimately are reducible to bits. Reality is thus described by equations involving numerical strings, which can be solved algorithmically.

12.5 The universe as a mathematical structure

That the reality around us is governed by mathematical principles is a well-known fact. Galileo Galilei asserted [55] that the universe is written in the language of mathematics. However, we may ask why mathematics is so effective in describing reality. According to Tegmark [56], this happens because the universe is essentially a mathematical structure, a set of elements in relationship with each other. We can identify these elements in elementary electric charges, the "1" bits of the program. In this sense, everything that is mathematically provable also exists physically. Mathematical existence equates to physical existence. In fact, many mathematical theories have been developed which have only later found their application in the real world. For example, 60 years after it was formulated, Einstein [6] used Riemannian geometry to describe gravity. According to this paradigm, all mathematics developed will sooner or later find its place in the physical world. A first step in this direction can be taken by substituting the identities $1 = e^{-i\frac{\alpha h_P c}{2Kq_e^2}}$ and $\pi = \alpha h_P c/2Kq_e^2$ inside various mathematical equations. This allows us to transform theorems developed in mathematical contexts into physical laws. Furthermore, since the universe is a mathematical structure, it means that it is possible to construct an axiomatic system (which, by describing a set consisting of a finite number of elements, the elementary electric charges, on a continuous background, spacetime, is necessarily subject to Gödel's incompleteness theorems?) very similar to those developed for arithmetic or computer science, to describe the physical world. This is because it is possible to reduce the entire universe to a sequence of "0" and "1".

12.6 Are we part of a simulation?

In the film Matrix, when Neo meets Trinity, he asks her: “What is Matrix?” She tells him that the answer is all around him. Matrix possesses him, surrounds him. The truth is that he was born into a prison for his mind. Today we know that phenomenal perception occurs in the brain and if the brain is deceived, false sensations can be created, just like in dreams. Thus, the pain of a wound, the sight of an object, the taste, do not exist, except in our mind. In this sense, everything we perceive is essentially illusory. In fact, as we have demonstrated, the universe is nothing more than a vast program, an enormous video game, an illusion interpreted as real by our brain. The world, matter, energy, spacetime, are essentially computational: everything is made of rules, laws, strings. According to digitalist physics [57], this inevitably implies the existence of an external programmer who has developed the program, the simulation in which we live. In this sense, human consciousness is not part of spacetime, it interacts with the world through a system of input and output, similar to what happens with computer programs, experiencing the world through the senses. Human consciousness is thus “causality” originating outside spacetime. This is the source of free will, which could not exist within a closed system because, at a macroscopic level, every action would correspond to a perfectly or statistically predictable reaction and therefore a deterministic outcome. Free will is possible only if there is something external that acts upon the system. The starting point of the chain of events. Everything begins with a choice, which then activates the domino chain of cause and effect. The more a person knows, the more they are able to see alternative paths. Choices represent the independent variables, and each choice will have a different effect on reality. Knowledge makes a person free, not a piece of the domino, but an active player, while ignorance makes them part of the causal chain, susceptible to influence, a slave. Moreover, considering that a choice represents an option between two states, it follows that the universe is fundamentally dual. Duality is at the basis of the dynamics of physical systems. Without opposites there is no differentiation, forces would not exist, and everything would be inert. Duality is a symmetry law that applies to every entity and at every level of existence. Everything that exists has formed and forms through consecutive ramifications (divisions or symmetries), like the branches of a tree. Hence arises the parallel with the tree of life. All existence can be traced back to a single root, the electrogravitational field. In this sense, elementary electric charge represents the cell (unit) of spacetime [*].

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[*] The Seal of the Rebis on the cover was taken from the Azoth of Basil Valentine (1613). The introduction has been adapted from "The Discontinuity of Nature" by Marco Capogni, published on INFN, Science for Everyone. The citations have been added subsequently and are not integral parts of the original article. Additionally, for the writing of this text, numerous sources from Wikipedia have been used, both in Italian and English (Paragraphs 1.1, 1.2, 6.1, 7.1, 8.1, 8.2, 8.3, 11.1, 11.2, 11.3). For Chapter 12, excerpts were used from the documentary "Harnessing The Power Of Information, Order and Disorder" by Jim Al-Khalili, Spark (Paragraph 12.1), and from the series "Matrix," accessible on the YouTube channel "Mortebianca" (Paragraph 12.6).

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FINAL NOTES

This text is only an introduction to the electrogravitational theory. By expanding these concepts, we will see how it can be applied to all physical phenomena. Among the various issues addressed, we will be able to demonstrate the equivalence principle, provide a solid explanation of the holographic principle, clarify the ER=EPR conjecture, and so on... Moreover, not less significantly, since the quantum of action can be represented in relation to other physical constants, we will be able to reformulate the entire quantum physics and physics in general.

Appendix

Conversion factors

TIME	$T_{uI} = 1 \cdot T_{uT}$
LENGTH	$R_{uI} = 1/\sqrt[4]{\alpha} \cdot R_{uT} \approx 3.42 \cdot R_{uT}$
VELOCITY	$\boldsymbol{v}_{uI} = 1/\sqrt[4]{\alpha} \cdot \boldsymbol{v}_{uT} \approx 3.42 \cdot \boldsymbol{v}_{uT}$
ACCELERATION	$\boldsymbol{a}_{uI} = 1/\sqrt[4]{\alpha} \cdot \boldsymbol{a}_{uT} \approx 3.42 \cdot \boldsymbol{a}_{uT}$
CURVATURE	$S_{uI} = \sqrt{\alpha} \cdot S_{uT} \approx 1/11.7 \cdot S_{uT}$
ENERGY	$E_{uI} = \sqrt[4]{\alpha} \cdot E_{uT} \approx 1/3.42 \cdot E_{uT}$
MASS	$m_{uI} = \sqrt[4]{\alpha^3}\, m_{uT} \approx 1/40 \cdot m_{uT}$
GRAVITATIONAL ATTRACTION FORCE	$\boldsymbol{F}_{g\,uI} = \sqrt{\alpha}\, \boldsymbol{F}_{g\,uT} \approx 1/11.7 \cdot \boldsymbol{F}_{g\,uT}$
UNIVERSAL GRAVITATIONAL CONSTANT	$G_{uI} = 1/\alpha\sqrt{\alpha}\, G_{uT} \approx 1600 \cdot G_{uT}$
GRAVITATIONAL PERMETTIVITY	$\varepsilon_{g\,uI} = \alpha\sqrt{\alpha}\, \varepsilon_{g\,uT} \approx 1/1600 \cdot \varepsilon_{g\,uT}$
COGRAVITATIONAL PERMEABILITY	$\mu_{g\,uI} = 1/\alpha\, \mu_{g\,uT} \approx 137 \cdot \mu_{g\,uT}$
ELECTRIC CHARGE	$q_{uI} = \sqrt{\alpha}\, q_{uT} \approx 1/11.7 \cdot q_{uT}$
COULOMB FORCE	$\boldsymbol{F}_{e\,uI} = \sqrt{\alpha}\, \boldsymbol{F}_{e\,uT} \approx 1/11.7 \cdot \boldsymbol{F}_{e\,uT}$
COULOMB CONSTANT	$K_{uI} = 1/\alpha\, K_{uT} \approx 137 \cdot K_{uT}$
ELECTRIC PERMETTIVITY	$\varepsilon_{e\,uI} = \alpha\, \varepsilon_{e\,uT} \approx 1/137 \cdot \varepsilon_{e\,uT}$
MAGNETIC PERMEABILITY	$\mu_{e\,uI} = 1/\sqrt{\alpha}\, \mu_{e\,uT} \approx 11.7 \cdot \mu_{e\,uT}$

Unitary conversion factors

LENGTH	$l_d \approx (7.8 \cdot 10^{-27} m^{-1}) \cdot d \cdot l_0$
VELOCITY	$\boldsymbol{v}_d \approx (7.8 \cdot 10^{-27} m^{-1}) \cdot d \cdot \boldsymbol{v}_0$
ACCELERATION	$\boldsymbol{a}_d \approx (7.8 \cdot 10^{-27} m^{-1}) \cdot d \cdot \boldsymbol{a}_0$
CURVATURE	$S_d \approx -(1.95 \cdot 10^{-28} m^{-1}) \cdot d \cdot S_0$

ENERGY	$E_d \approx -(6.65 \cdot 10^{-28} m^{-1}) \cdot d \cdot E_0$
MASS	$m_d \approx -(5.69 \cdot 10^{-29} m^{-1}) \cdot d \cdot m_0$
GRAVITATIONAL ATTRACTION FORCE	$\boldsymbol{F}_{g\,d} \approx -(1.9 \cdot 10^{-28} m^{-1}) \cdot d \cdot \boldsymbol{F}_{g0}$
UNIVERSAL GRAVITATIONAL CONSTANT	$G_d \approx (3.64 \cdot 10^{-24} m^{-1}) \cdot d \cdot G_0$
GRAVITATIONAL PERMETTIVITY	$\varepsilon_{g\,d} \approx -(1.42 \cdot 10^{-30} m^{-1}) \cdot d \cdot \varepsilon_{g\,0}$
COGRAVITATIONAL PERMEABILITY	$\mu_{g\,d} \approx (3.11 \cdot 10^{-25} m^{-1}) \cdot d \cdot \mu_{g\,0}$
ELECTRIC CHARGE	$q_d \approx -(1.95 \cdot 10^{-28} m^{-1}) \cdot d \cdot q_0$
COULOMB FORCE	$\boldsymbol{F}_{e\,d} \approx -(1.95 \cdot 10^{-28} m^{-1}) \cdot d \cdot \boldsymbol{F}_{e0}$
COULOMB CONSTANT	$K_d \approx (3.11 \cdot 10^{-25} m^{-1}) \cdot d \cdot K_0$
ELECTRIC PERMETTIVITY	$\varepsilon_{e\,d} \approx -(5.69 \cdot 10^{-29} m^{-1}) \cdot d \cdot \varepsilon_{e\,0}$
MAGNETIC PERMEABILITY	$\mu_{e\,d} \approx (2.66 \cdot 10^{-26} m^{-1}) \cdot d \cdot \mu_{e\,0}$

INVARIANTS

THE PRODUCT	Gmm
THE PRODUCT	Kqq
THE RATIO	K/μ_g
THE RATIO	S/q
THE RATIO	$\boldsymbol{F}_g/\boldsymbol{F}_e$
ELECTRIC FIELD	$\boldsymbol{E}$
FINE-STRUCTURE CONSTANT	α

NOTE: The subscripts uT and uI are often used generically to indicate whether the system is experiencing the expansion (contraction) of the universe. Additionally, instead of the speed of light c, sometimes the generic velocity v is used, which also includes the component due to spacetime. Then, equation (1.18) can be formulated either in the current way or as a variation of energy in the 4 components. In Chapter 8, the Schrödinger equation was used to derive the structure of elementary particles. In equation (9.4), it was considered that only one quark of the proton interacts at a time; the same reasoning applies when we calculate the neutron-electron mass ratio. Finally, both in the Abstract and in Chapter 12, the term “matrix” was used instead of “tensor”, due to the cinematic representation of reality given by the movie ”The Matrix”.

GRAVITOELECTRIC EQUATIONS

It is possible to invert the (3.4) relationship to define the charge of the graviphoton in relation to its mass, but this results in the loss of information about the sign.

$$q_i = z_i q_e = z_i \sqrt{\frac{m_S c^2 l_S}{K}} \qquad (z_i \in \mathbb{Z}) \tag{3.4b}$$

We can then substitute this relationship into Maxwell's equations [3], in order to obtain the gravitoelectric equations, which are dual to the electrogravitational ones.

$$\nabla \cdot \mathbf{E} = 4\pi \sqrt{K m_S c^2 l_S}\, \rho_z \tag{4.8b}$$

$$\nabla \cdot \mathbf{B} = 0 \tag{4.9b}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \tag{4.10b}$$

$$\nabla \times \mathbf{B} = \frac{4\pi}{c^2} \sqrt{K m_S c^2 l_S}\, \boldsymbol{J}_z + \frac{1}{c^2} \frac{\partial \mathbf{E}}{\partial t} \tag{4.11b}$$

Here the fields **E** and **B**, defined by Jefimenko in "Electricity and Magnetism" for the continuous case, are described by the relationships (locally $\boldsymbol{v}$ reduces to c):

$$\mathbf{E} = \sqrt{K m_S c^2 l_S} \int \left\{ \frac{[\rho_z]}{r^3} + \frac{1}{r^2 c} \left[\frac{\partial \rho_z}{\partial t} \right] \right\} \boldsymbol{r}\, dV' - \frac{\sqrt{K m_S c^2 l_S}}{c^2} \int \frac{1}{r} \left[\frac{\partial (\rho_z \boldsymbol{v})}{\partial t} \right] dV' \tag{4.12b}$$

$$\mathbf{B} = \frac{\sqrt{K m_S c^2 l_S}}{c^2} \int \left\{ \frac{[\rho_z \boldsymbol{v}]}{r^3} + \frac{1}{r^2 c} \left[\frac{\partial \rho_z \boldsymbol{v}}{\partial t} \right] \right\} \times \boldsymbol{r}\, dV' \tag{4.13b}$$

Among the solutions of the gravitoelectric equations are the gravitoelectric waves. These describe the behavior of the graviphoton's charges. Given the simplified versions of the electric **E** and magnetic **B** fields, we can derive Planck's law.

$$\mathbf{E} = \frac{\sqrt{K m_S c^2 l_S}}{r^2}\, z\, \hat{\mathbf{k}}_\mathbf{1} = \mathbf{E}_S z \tag{5.1b}$$

$$\mathbf{B} = \frac{\sqrt{K m_S c^2 l_S}}{c\, r^2}\, z\, \hat{\mathbf{k}}_\mathbf{2} = \mathbf{B}_S z \tag{5.2b}$$

Here $\hat{\mathbf{k}}_1$ and $\hat{\mathbf{k}}_2$ represent the unit vectors associated with the **E** and **B** fields, and z the number of charges (the sign of z is that of the charges). Additionally, $\mathbf{E}_S$ and $\mathbf{B}_S$ are the electric and magnetic fields in Stoney units. Given the e.m. Poynting vector:

$$\mathbf{S} = \frac{c^2}{4\pi K}\ \mathbf{E} \times \mathbf{B} \tag{4.18b}$$

To determine the power emitted by the source, it is necessary to integrate over the entire surface of wavefront, which is equivalent to multiplying by the surface area.

$$P_S = \int_A \mathbf{S} \cdot \hat{\boldsymbol{n}}\, dA = (4\pi r^2)\frac{c^2}{4\pi K}\left(\frac{\sqrt{K m_S c^2 l_S}}{r^2}\ z\ \cdot \frac{\sqrt{K m_S c^2 l_S}}{c\, r^2}\ z\right) \tag{5.3b}$$

Taking into account that locally $r^2 = c^2 t^2$, the power associated with the wave is:

$$P_S = c\, m_S l_S \frac{z^2}{t^2} \tag{5.4b}$$

Given that $|z|/t = v$ represents the emission frequency of elementary electric charges, if we multiply by $2\pi/v$ (by multiplying by 2π, we are considering both charges of the graviphoton), we obtain the Stoney energy of the gravitoelectric wave:

$$E_S = 2\pi c\, m_S l_S v = h_S v \tag{5.5b}$$

Here h_S represents the Stoney constant, m_S is the Stoney mass, and l_S is the Stoney length. On the other hand, as we saw in Chapter 5, when the graviphoton is in a region of locally flat spacetime, its energy is approximately 137 times greater. The Planck energy carried by the gravitoelectric wave in locally flat spacetime is:

$$E_P = \frac{2\pi c\, m_S l_S}{\alpha} v = 2\pi c\, m_P l_P v = h_P v \tag{5.6b}$$

Here h_P represents the Planck constant, m_P the Planck mass, and l_P the Planck length. In the case of gravitoelectric fields, it is also possible to formulate the equations in terms of scalar and vector potentials. These are derived by inserting equation (3.4b) into the electrodynamics equations. Similarly, a gravitoelectric type stress-energy tensor can be defined. In this case, quantization of the field equation is achieved by introducing the square of the unit length in the denominator of various components of the stress-energy tensor, following the approach recommended in Chapter 7. The same applies to other types of quantization previously described.

ELECTROMAGNETISM AND PLANCK'S LAW

Planck's law can be derived using electromagnetism alone. Given a generic charge q_i, it can be expressed as a multiple of the elementary electric charge q_e.

$$q_i = z_i q_e \quad (z_i \in \mathbb{Z}) \tag{3.4c}$$

We can substitute this relationship into Maxwell's equations, so that they depend on the number density of charges ρ_z. Among the solutions of Maxwell's equations are electromagnetic waves. These describe the behavior of the electric **E** and magnetic **B** fields, which locally are expressed by the following “simplified” relationships:

$$\mathbf{E} = \frac{K q_e}{r^2}\, z\, \hat{\mathbf{k}}_1 \tag{5.1c}$$

$$\mathbf{B} = \frac{K q_e}{c\, r^2}\, z\, \hat{\mathbf{k}}_2 \tag{5.2c}$$

Here $\hat{\mathbf{k}}_1$ and $\hat{\mathbf{k}}_2$ represent the unit vectors associated with the fields **E** and **B**, and z the number of charges (the sign of z is that of the charges). Given the Poynting vector:

$$\mathbf{S} = \frac{c^2}{4\pi K}\, \mathbf{E} \times \mathbf{B} \tag{4.18b}$$

To determine the power radiated by a point source, in the case of monochromatic emission, it is necessary to integrate over the surface area $4\pi r^2$ of the wavefront.

$$P_S = \int_A \mathbf{S} \cdot \hat{\boldsymbol{n}}\, dA = (4\pi r^2)\frac{c^2}{4\pi K}\left(\frac{K q_e}{r^2}\, z \cdot \frac{K q_e}{c\, r^2}\, z\right) \tag{5.3c}$$

Taking into account that locally $r^2 = c^2 t^2$, the power associated with the wave is:

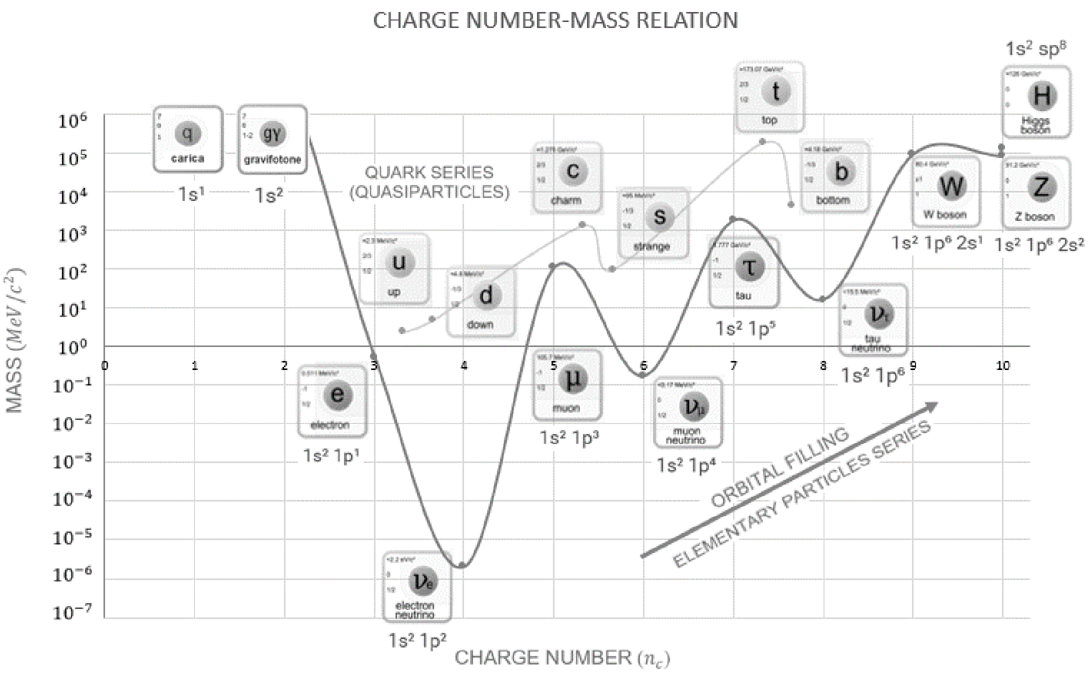
$$P_S = \frac{K q_e^2}{c}\frac{z^2}{t^2} \tag{5.4c}$$

Given that $|z|/t = v$ represents the emission frequency of elementary electric charges, if we multiply by $2\pi/\alpha v$ (by multiplying by 2π, we are considering both charges of the photon), we obtain the Planck energy of the electromagnetic wave:

$$E_P = \frac{2\pi K q_e^2}{c\alpha} v = \frac{Z_0 q_e^2}{2\alpha} v = h_P v \tag{5.6c}$$

CHARGE NUMBER-MASS RELATIONSHIP

To describe an atom, two characteristics are fundamental, its weight and its atomic number. The relationship between atomic number and atomic mass shows significant linearity. However, in the case of elementary particles, the situation is more complex. As the charge number increases, up to the Higgs boson, there is an exponential (oscillating) increase in mass observed. Two main trends can be identified: one for neutral particles (the 3 neutrinos, the Z^0 boson, and the Higgs boson) with lower mass/energy, and another for charged particles (the 3 charged leptons and the $W^{-/+}$ boson). The (gravitational) mass of the graviphoton (boson) varies depending on its position (when isolated, it can range between the Stoney and Planck masses), yet this mass cannot be measured because the graviphoton cannot interact with other graviphotons except itself. The mass of the free (unshielded) elementary electric charge (boson) should be equal to the minimum mass required to form a black hole (a black hole should precisely coincide with an unshielded elementary electric charge because the force binding the two elementary electric charges in flat spacetime, in the graviphoton, equals the Planck force c^4/G, the force necessary to tear spacetime apart). Quarks (*quasiparticles*) are also indexed on the graph. The masses of quarks do not differ much from those of the leptons from which they derive. Gluons are not indexed as they represent only a temporarily bound state of a lepton with a free electric charge. The electric configuration of each particle is indicated in the graph.



NOTE: Confirmations supporting this type of schematization include the mass ratio between the proton and the electron, and neutron and electron, conversion factors predicting a force that increases with distance (strong force), and the graviphoton, which is predicted to consist of two elementary electric charges of opposite sign.

LEGEND

THEORET. AND MEAS. VALUES OF THE UNIV.	uT, uI
CONVERSION FACTORS	$f[\,]$
PLANCK CONSTANT	$h_P \approx 6.626 \cdot 10^{-34}\, J \cdot s$
STONEY CONSTANT	$h_S \approx 4.836 \cdot 10^{-36}\, J \cdot s$
PLANCK LENGTH	$l_P \approx 1.616 \cdot 10^{-35}\, m$
STONEY LENGTH	$l_S \approx 1.381 \cdot 10^{-36}\, m$
PLANCK TIME	$t_P \approx 5.391 \cdot 10^{-44}\, s$
STONEY TIME	$t_S \approx 4.605 \cdot 10^{-45}\, s$
PLANCK CHARGE	$q_P \approx 1.876 \cdot 10^{-18}\, C$
ELEMENTARY OR STONEY CHARGE	$q_S = q_e \approx 1.601 \cdot 10^{-19}\, C$
PLANCK MASS	$m_P \approx 2.176 \cdot 10^{-8}\, kg$
STONEY MASS	$m_S \approx 1.859 \cdot 10^{-9}\, kg$
FINE-STRUCTURE CONSTANT	$\alpha \approx 1/137$
IMPEDANCE OF FREE SPACE	$Z_0 \approx 376.7\, \Omega$
DENSITY OF DIPOLES (OR GRAVIPHOTONS)	$\rho_n = n/V$
CURRENT DENSITY VECTOR	$\boldsymbol{J}_n = \rho_n \boldsymbol{v}$
ELECTRIC AND MAGNETIC FIELD	**E**, **B**
GRAVITATIONAL AND COGRAVITAT. FIELD	**g**, **K**
STRESS TENSOR	σ_{ij}
EINSTEIN TENSOR	$G_{\mu\nu}$
RIEMANN TENSOR	$R_{\mu\nu}$
SCALAR CURVATURE	R
METRIC TENSOR	$g_{\mu\nu}$
STRESS-ENERGY TENSOR	$T_{\mu\nu}$