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# Las constantes naturales como propiedades de la estructura del Espacio-tiempo. Un diseño geométrico y matemático

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**Resumen**
En la física actual existen dos constantes Naturales con significados que permanecen sin resolver: la constante Cosmológica y la de Estructura Fina. Ambos están relacionados con la teoría de la relatividad y la mecánica cuántica. En este escrito intentamos dar significado a cada una de estas constantes y la relación que puede existir entre ellas, proponiendo un nuevo sistema de unidades basado en la Estructura del Espaciotiempo. Ampliaremos este nuevo concepto a cuestiones no resueltas en física y cosmología, también describiremos el proceso mediante el cual se desarrollaron las premisas de la estructura del Espaciotiempo para proporcionar una base a nuestra tesis de que el Espaciotiempo está cuantizado en vértices equidistantes vinculados a la energía que separan la longitud de onda del electrón Compton y tiempo. El Espaciotiempo es una estructura omni-tensional que contiene la energía y la masa que componen el Universo. Dentro de esta estructura, los átomos y los fotones experimentan un movimiento cuantificado de vértice a vértice, donde el cambio de ángulo entre los vértices estructurales produce la curvatura del Espaciotiempo. Proponemos que la constante de Estructura Fina, está relacionada con la estructura del Espaciotiempo y que las propiedades físicas de la materia y la energía se pueden traducir a Unidades Estructurales o de Espaciotiempo, donde las constantes Naturales se describen mediante relaciones matemáticas entre los tres números puros $\pi$, $\phi$ y $\alpha$.

**Palabras clave**: Constante Cosmológica, Constante de Estructura Fina, Espaciotiempo, Constantes Naturales.

## Natural constants as properties of the Spacetime structure. A geometrical and mathematical design

**Abstract**
In current physics there are two Natural constants with meanings that remain unresolved: the Cosmological and the Fine Structure constants. Both are related to the theory of relativity and quantum mechanics. Here we attempt to give meaning to each of these constants and the relationship that can exist between them by proposing a new system of units based on Spacetime Structure. We will extend this new concept to unsolved questions in physics and cosmology, as well as describing the process by which the Spacetime Structure premises were developed to provide a basis for our thesis that Spacetime is quantized in energy-linked equidistant vertices separating the Compton electron wavelength and time. Spacetime is an omni-tensional structure that contains the energy and mass composing the Universe. Within this structure atoms and photons undergo quantized movement from vertex to vertex, where the angle change between structural vertices produces the Spacetime curvature. We propose that the Fine Structure constant is related to Spacetime Structure, and that physical properties of matter and energy can be translated to Structural or Spacetime Units, where Natural constants are described by mathematical relationships between the three pure numbers $\pi$, $\phi$ and $\alpha$.

**Keywords**: Cosmological constant, Fine Structure constant, Spacetime, Natural constants.

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## 1. Introduction

In the first part, the meanings of the Cosmological and Fine Structure constants, necessary to arrive to the four premises that would characterize the Structure of the Spacetime, will be proposed. Next, the translation of our International System of units to this frame of reference will be explained in detail, checking their equivalence. Once the translation to Structural Units is explained, we will face several open questions in current physics through this new point of view, such as the concepts of mass and energy, the Big Bang, Entropy, the Dirac/Eddington hypothesis of large numbers or the proportional relationship between the different Natural Constants, among others, also connecting calculations performed with recent publications based on experimental data. In the last part, a correlation is proposed between the bended angle of the Spacetime‘s Structure and acceleration.

## 2. The curvature volume of the Quantum vacuum as responsible for gravity

Recent observations of the Planck Satellite have estimated the value of the vacuum density of free space equal to $\delta_v = 5.96 \times 10^{-27}$ kg/m$^3$ [1]. We propose that this is the value of the Spacetime texture and equivalent to the Quantum Vacuum density. According to Relativity theory introduced by Einstein, the energy contained in a mass can bend Spacetime and this bending effect is responsible for gravity. We suggest that this is due to the energy equivalence with the Quantum Vacuum,

$$D_v \times\ V_c =\ mc^2. \tag{1}$$

Where $D_v =\ \delta_v \times\ c^2$ is the energy density of the Quantum Vacuum and $V_c$ the curvature's Spacetime volume or the region of the Universe affected by a determined mass m. Following these calculations, the energy contained in a mass will bend a Spacetime bubble with an equivalent energy. If we consider the Earth as an example with a mass of $5.97 \times 10^{24}$ kg, we obtain a volume of curvature $V_c = 1 \times 10^{51}$ m$^3$. This value represents the volume of the gravitational field from which Spacetime stops curving because the effect of the Earth. In the case of the Sun, the $V_c$ amounts to a value of $3.32 \times 10^{56}$ m$^3$, therefore the elliptical orbits defined by Kepler would result from the interaction of the Spacetime spheres curved by each celestial body.

### 2.1. Determination of the frequency and wavelength of the Quantum vacuum

Although the density in localized points may offer irregularities in the gravitational field, the volume of curvature of the Vacuum ($V_c$) will be considered spherical and all the calculations will be made from this assumption. Since the Spacetime Structure that holds the mass would not have any direction, this curvature is located around its center of gravity, simplifying to a homogeneous density. It can be calculated that there is a direct proportionality relationship between the result of dividing gravitational acceleration by the spherical radius acquired by any celestial body, which we will call the Singularity parameter ($g_s$) and its final density. What is intended is to find the analog in time by unit equivalence to the Cosmological constant, whose value is m$^{-2}$ by dimensional analysis. Taking the Earth and the Sun as examples again, we can find the Singularity parameter of the Quantum Vacuum ($g_s$), knowing its density and considering it to be uniform.

Earth, if 9.8 m/s$^2$/6371000 m is equal to 5571 kg/m$^3$ and $g_s$ of Quantum Vacuum is equal to $5.96 \times 10^{-27}$ kg/m$^3$. the Singularity parameter $g_s$ is $1.645 \times 10^{-36}$ s$^{-2}$.

Sun, if 274 m/s$^2$/695700000 m is equal to 1408 kg/m$^3$ and $g_s$ of Quantum Vacuum is equal to $5.96 \times 10^{-27}$ kg/m$^3$. the Singularity parameter $g_s$ is $1.66 \times 10^{-36}$ s$^{-2}$.

We can also develop the formula of the proportionality between the Singularity parameter ($g_s$) and Quantum Vacuum density ($\delta_v$), obtaining the following equation for any celestial body gravity ($g$),

$$g = \frac{3 g_s M}{4\pi\delta_v r^2}. \tag{2}$$

Taking M as its mass and r as its radius, we deduce that the Gravitational constant G, follows the equation,

$$G = \frac{3 g_s}{4\pi\delta_v}. \tag{3}$$

Then, modifications in the density of the Vacuum ($\delta_v$) would imply variation in the Singularity parameter ($g_s$), keeping the value of Gravitational constant over time at $6.67 \times 10^{-11}$ m$^3$/(kg×s$^2$). Einstein's Cosmological constant ($\Lambda$) whose current value is $1.11 \times 10^{-52}$ m$^{-2}$ is related to the Vacuum density by the formula,

$$\delta_v = \frac{\Lambda c^2}{8\pi G}. \tag{4}$$

Where c is the speed of light. We can substitute G in formula (4) for the expression of G in equation (3) and isolating the speed of light give the expression,

$$c^2 = \frac{6 g_s}{\Lambda}. \tag{5}$$

Looking closely at this formula, we obtain that the numerator $6g_s$ is the square of a frequency and the denominator $\Lambda$ the inverse of the square of a wavelength. We can rewrite it as the well-known formula (6), which relates the frequency and the wavelength of a photon with the speed of light,

$$c = f_g \lambda_g. \tag{6}$$

We are going to consider $f_g$ and $\lambda_g$ as the Gravitational frequency and wavelength, respectively, thus knowing the data of the density of the Quantum Vacuum and Einstein's Cosmological constant, the frequency and wavelength of the Gravitational Quantum Vacuum field, would have the following values $f_g = 3.155 \times 10^{-18}$ s$^{-1}$ and $\lambda_g = 9.49 \times 10^{25}$ m.

## 2.2. Meaning of the frequency and wavelength of the vacuum

In the previous calculations, the Quantum Vacuum is defined by a wave of frequency $3.155 \times 10^{-18}$ s$^{-1}$ and length $9.49 \times 10^{25}$ m whose forehead is moving at the speed of light. The singularity that produced the wave could have occurred 10.05 billion years ago $3.155 \times 10^{-18}$ s$^{-1}$, so it would have travelled $9.49 \times 10^{25}$ m at a speed of $3 \times 10^8$ m/s, this would represent the Universe radius. Einstein's Cosmological constant acquires the meaning of being the inverse of the square of the radius of the Universe, as Einstein first suggested and would correspond to the distance travelled by the wave front from the Big Bang. In this way, there would be a discrepancy between the value calculated in this study and the one currently accepted, which places the Big Bang 13.8 billion years ago, if we consider that the mass is capable of bending Spacetime, the calculations carried out in this study does not consider this curvature, therefore $9.49 \times 10^{25}$ m and $3.155 \times 10^{-18}$ s$^{-1}$ correspond to a straight line between the origin and the border of our Universe, then these calculations are related to a Euclidean Spacetime Structure. We suggest that the introduction of Cosmic Inflation, could be due to the addition of the Spacetime curvature (time and space dilation) that produces the mass contained in the Universe and that appears in our experimental data as the Universe presents a non-Euclidean Spacetime Structure.

## 2.3. Characterization of the Quantum vacuum. Deduction of the formula to calculate the vacuum breaking force and the formation of a Black Hole

The physicist Karl Schwarzschild, deduced from Einstein's field equations, the expression for the formation of a black hole,

$$r_s = \frac{2GM}{c^2}. \tag{7}$$

the term $r_s$ the Schwarzschild radius which defines a black hole of a given mass according to its size and spherical symmetry. The force necessary for the masses of any celestial body to reach the Schwarzschild radius, and therefore the formation of a black hole, can be calculated from equations (7) and (8),

$$g = \frac{GM}{{r_s}^2}. \tag{8}$$

from this expression, the generic formula F= ma can be defined as follows,

$$F_g = \frac{c^4}{4G}. \tag{9}$$

this force is a constant that does not depend on mass being analogous to the maximum relativistic force $F_g$ that can be produced before the Structure breaks to form a black hole. Spacetime therefore presents an omnitensional integrity or tensegrity, which are terms introduced by Kenneth Snelson and Buckminster Fuller from the observations of Nature structures, where the force applied in one point is distributed to the whole structure [2].

## 2.4. Calculation to obtain the total mass of the Universe

When the force that the Quantum Vacuum Structure can resist is known, we can begin by assuming that the Universe is expanding with the greatest force it can contain $F_g = 3.02 \times 10^{43}$ N. Its total energy can be calculated from the expression $Energy = Force \times Distance$. Taking the distance as the Universe radius ($r_U$), this expansion energy should be equal to the total energy of the Universe the next equation can be proposed,

$$\frac{c^2}{4G} r_U = M_U. \tag{10}$$

According to (10), $M_U$ would increase proportionally to the radius of the Universe, so matter would continually be created as a result of its expansion. This idea was first introduced by Fred Hoyle and Narlikar [3]. If we suppose $r_U$ to be the distance traveled by the wave that forms the Quantum Vacuum, whose value is $9.49 \times 10^{25}$ m, $M_U$ acquires a current value of $3.2 \times 10^{52}$ kg.

## 2.5. Density of the universe, checking Cosmological Constant proposed meaning

As a conclusion to the previous sections, the Universe would correspond to a Spacetime sphere whose radius is expressed by the Cosmological constant with a total volume of $3.58 \times 10^{78}$ m$^3$, with a total mass about $3.2 \times 10^{52}$ kg therefore, its total density ($\delta_U$) acquires a value about $8.94 \times 10^{-27}$ kg/m$^3$. Replacing the term $M_U$ in the formula (10) by $M_U = \delta_U \times V_U$ we obtain,

$$\frac{c^2}{4G} r_U = \frac{\delta_U 4\pi r_U^3}{3}. \tag{11}$$

Clearing the density,

$$\delta_U = \frac{3c^2}{16\pi G\ r_U^2}. \tag{12}$$

The similarity of the formula (12) with the known equation of the density of the Vacuum (13) derived from the Einstein field equations, where the Cosmological constant (Λ) appears, can be observed,

$$\delta_v = \frac{\Lambda c^2}{8\pi G}. \tag{13}$$

If we substitute the value of the Cosmological constant for $\Lambda = \frac{1}{r_U^2}$, the inverse of the Universe radius squared, we can obtain,

$$\delta_v = \frac{c^2}{8\pi G r_U^2}. \tag{14}$$

As always (14)/(12)= (2)/(3) the density of the Vacuum would represent 2/3 of the total Universe density, keeping this relationship constant, regardless of the age of the Universe. Then, the 66.7 % of the total mass of the Universe, or what is equivalent to its energy, would be due to the Quantum Vacuum, this value is very similar to the one established as belonging to Dark Energy, so it is proposed, that both concepts would be synonyms and equivalents to the same Spacetime Structure.

## 2.6. The expansion of the Universe and the Hubble constant (parameter)

The parameter that determines the Hubble-Lemaître law, called Hubble constant, is expressed with the formula,

$$H_0^2 = \frac{\delta_c 8\pi G}{3}. \tag{15}$$

Where $H_0$ corresponds to the Hubble-Lemaître constant and $\delta_c$ to the critical density of the Universe. This value was defined, when observing that objects in extragalactic space, more distant than 10 megaparsecs, present wavelength shifts towards the red (redshift), this has been interpreted as proof that galaxies are moving away from each other, due to the expansion of the Universe and the well-known Doppler effect, in accordance with the Big Bang theory. Currently, there is a great difference in the values obtained in the measurements made on the Hubble-Lemaître constant, depending on the method used, with discrepancies up to 5$\sigma$. This has generated a great debate among the scientific community, known as the Hubble tension, still unresolved.

Relating the formula that would define the total Universe density (12), obtained in the previous section, with (15) equation, we set the value of the critical density equal to the total one ($\delta_c = \delta_U$), since for this proposed model, the density of the Universe would always be equal to the critical, allowing the expansion force to be kept constant at $3.02 \times 10^{43}$ N, obtaining:

$$H_0 = \frac{c}{\sqrt{2} r_U}. \tag{16}$$

Substituting $r_U$ for $9.49 \times 10^{25}$ m the value for the Hubble parameter is $68.97 (Km/s)/Mpc$, remarkably close to the value recently obtained by direct CMB observations [4]. It is suggested that the current large discrepancy could be due to the different times in which the photons that we observe were emitted, with different values of the Hubble parameter, which would produce a distortion on the measurement. We consider the CMB, (Cosmic Microwave Background) as a reference by not depending on this variable, but on when the Big Bang occurred.

| Years | Seconds | Universe radius | Universe mass Kg. | Volum M³ | Total density Kg/m³ |
|---|---|---|---|---|---|
| 1000000 | 3,1536E+13 | 9,4608E+21 | 3,19E+48 | 3,5471E+66 | 8,99E-19 |
| 50000000 | 1,5768E+15 | 4,7304E+23 | 1,59E+50 | 4,4339E+71 | 3,60E-22 |
| 100000000 | 3,1536E+15 | 9,4608E+23 | 3,19E+50 | 3,5471E+72 | 8,99E-23 |
| 1000000000 | 3,1536E+16 | 9,4608E+24 | 3,19E+51 | 3,5471E+75 | 8,99E-25 |
| 1500000000 | 4,7304E+16 | 1,4191E+25 | 4,78E+51 | 1,1971E+76 | 3,99E-25 |
| 5000000000 | 1,5768E+17 | 4,7304E+25 | 1,59E+52 | 4,4339E+77 | 3,60E-26 |
| 8000000000 | 2,52288E+17 | 7,5686E+25 | 2,55E+52 | 1,8161E+78 | 1,40E-26 |
| 10000000000 | 3,1536E+17 | 9,4608E+25 | 3,19E+52 | 3,5471E+78 | 8,99E-27 |
| 12000000000 | 3,78432E+17 | 1,1353E+26 | 3,83E+52 | 6,1294E+78 | 6,24E-27 |
| 15000000000 | 4,7304E+17 | 1,4191E+26 | 4,78E+52 | 1,1971E+79 | 3,99E-27 |

**Table 1**. In the attached table, different parameters are calculated as function of the Cosmic age.

## 2.7. Evolution of the Universe

Once the equation (10) $c^2 \times r_U/4G = M_U$ and (12) $\delta_U = 3c^2/(16\pi G\ r_U^2)$ for the mass and density of the Universe have been established, the evolution of both parameters can be known as a function of the expansion of the Universe.

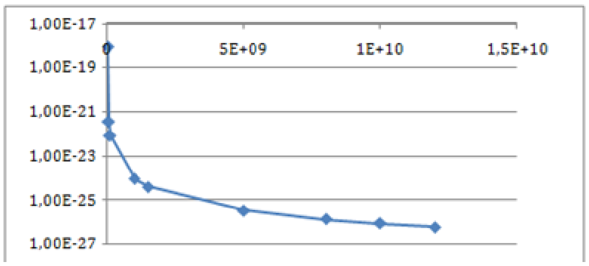


**Figura 1**: From Table 1 data, it is represented the Universe total density ($\delta_U$) at different Universe ages, the proposed model adjusts to a strong initial expansion, followed by an asymptotic stagnation in the total density of the Universe.

## 2.8. Quantum vacuum/spacetime structure

The Theory of Loop Quantum Gravity presents a similar approach to this study, where the Spacetime would be formed by a finite number of quantized loops [5]. We also suggest that this Structure is omni-tensional and holds the mass and energy inside the Universe. Once the total energy of the Universe has been postulated, the number of vertices connected by quantized loops of this Structure can be determined, assuming that the frequency of each vertex is equal to the Gravitational frequency, the inverse of the age of the Universe. Therefore, we will apply the formula,

$$M_U c^2 = \frac{c^4}{4G} r_U = N_U h f_g. \tag{17}$$

$N_U$ being the number of Spacetime Structural vertices. In equation (17) the total energy contained in the Universe is equaled, the first term being the general expression of Einstein's energy, the second the expansion of the Universe and the third the quantized energy of the total vertices formed. Isolating $N_U$,

$$\frac{c^4}{4Ghf_g} r_U = N_U. \tag{18}$$

substituting for the actual calculated values, where $r_U = 9.5 \times 10^{25}$ m and $f_g = 3.155 \times 10^{-18}$ s$^{-1}$ we obtain that the Universe would contain, at its current age, $1.37 \times 10^{120}$ vertices. In previous sections, it was obtained that the density of the Vacuum would correspond to 2/3 of the total density of the Universe, therefore, following the analogy with Spacetime, it would be formed by $9.13 \times 10^{119}$ vertices, the rest 1/3 vertices would be transformed into mass, through the whole Cosmic age.

## 2.9. Calculation of bending spacetime volume energy

To verify that the calculations carried out conform to this hypothesis, the energy that the volume of the Earth's curvature would contain will be determined, that is, the amount of energy corresponding to the Quantum Vacuum or Spacetime that would sustain the Earth within the Universe and that would have to be equal to the total energy contained in its mass. Considering the dimensions calculated for the current Universe, with a volume about $3.58 \times 10^{78}$ m$^3$. of Quantum Vacuum and $9.13 \times 10^{119}$ being the number of vertices that form the Spacetime Structure, 1 m3. of Universe would contain $2.55 \times 10^{41}$ vertices, if the total energy of the Universe is $2.88 \times 10^{69}$ Joules, with a total of $1.37 \times 10^{120}$ vertices formed since Big Bang, each vertex would contain $2.102 \times 10^{-51}$ Joules. Applying the formula exposed at the beginning of this paper, $D_v \times V_c = m \times c^2$ (1), being Earth's mass equal to $5.97 \times 10^{24}$ kg and the Vacuum density $5.96 \times 10^{-27}$ kg/m$^3$, we obtain a curvature volume of $1 \times 10^{51}$ m$^3$:

**Earth's energy**= $5.97 \times 10^{24} \times c^2 = 5.36 \times 10^{41}$ Joules. Earth's Vacuum curvature $energy = 1 \times 10^{51}$ m$^3$ $\times$ ($2.55 \times 10^{41}$ $Vertices$/m$^3$)$\times$($2.102 \times 10^{-51}$ Joules/Vertex)= $5.36 \times 10^{41}$ Joules.

In this way, the suggested equation about the equivalence of energies between a celestial body, such as the Earth and the Structure of Spacetime or Quantum Vacuum that would produce gravity is checked.

## 2.10. Compton wavelength of each vertex of the structure

From the experimental data of the density of the Vacuum $5.96 \times 10^{-27}$ kg/m$^3$, it has been obtained that the Universe would have created $1.37 \times 10^{120}$ Spacetime vertices since its inception, with a total mass of $3.2 \times 10^{52}$ kg, so the mass of a vertex ($m_V$) being $2.33 \times 10^{-68}$ kg that coincide with the mass indicated in some studies for a graviton [6]. Then, we proceed to equate Einstein's and Planck's equations, that characterize the energy of a particle and a photon, respectively, with the values indicated for each vertex,

$$E_v = m_v c^2 = h f_g. \tag{19}$$

Since $m_v = 2.33 \times 10^{-68}$ kg, $f_g = 3.155 \times 10^{-18}$ s$^{-1}$. and $E_v$ the energy of a vertex, we obtain a value of $2.1 \times 10^{-51}$ Joules in both cases, this could indicate that each vertex would follow a wave-particle behavior, under this assumption, we will calculate the Compton wavelength of a vertex, knowing its mass, we will solve for the wavelength corresponding to a photon of the same energy, using the Compton's equation,

$$\lambda_g = \frac{h}{m_v c}. \tag{20}$$

With a result of $\lambda_g = 9.49 \times 10^{25}$ m as Structural vertex wavelength and equivalent to the Universe radius, as previously we exposed.

## 3. The Fine Structure constant and the Universe radius in the same equation

Since Arnold Sommerfeld, introduced the Fine Structure constant in 1916 deducing the equation,

$$\frac{hc}{2\pi k_c e^2} = 137.035\ldots \tag{21}$$

This result has constituted one of the great mysteries of current physics, as from the relationship between such fundamental constants as Planck constant ($h$), the speed of light ($c$), the number $\pi$, the Coulomb constant ($k_c$) and the square of the fundamental electric charge ($e^2$) a dimensionless number arise and therefore, independent of the system of units used. As the physicist Lederman indicated, scientists from another planet anywhere in the Universe could have reached this result, regardless of the system of units used to describe the different physical phenomena. With the formulas obtained in the previous sections, we will try to isolate this value. Starting by the equilibrium between the forces that govern the movement of an electron in a hydrogen atom, following the classical Bohr model and considering the application of this, as only acceptable in the hydrogen atom, we will apply the well-known formula, which equates the centrifugal force to the electric force of the atom,

$$\frac{m_e v_e^2}{r_h} = \frac{k_c e^2}{r_h^2}. \tag{22}$$

Where $m_e$ is the mass of the electron, the velocity of the electron $v_e$ and $r_h$ the classical radius of a hydrogen atom. In relation to the following formula, deduced from this study and that would establish the equality of energies between the electron mass and the Vacuum,

$$m_e c^2 = N_e h f_g. \tag{23}$$

Where $N_e$ is the number of Spacetime vertices, which would interact with the mass of the electron to hold it inside Spacetime, $h$ the Planck constant and $f_g$ the frequency of each vertex. Isolating $m_e$ from formula (23) and substituting in equation (22), we obtain,

$$\frac{N_e h f_g v_e^2}{c^2} = \frac{k_c e^2}{r_h}. \tag{24}$$

Interpreting that the Gravitational frequency would be equal to the speed of light divided by Universe radius,

$$f_g = \frac{c}{r_U}. \tag{25}$$

It can be established that,

$$\frac{N_e h c v_e^2}{c^2 r_U} = \frac{k_c e^2}{r_h}. \tag{26}$$

The first interpretation of the Fine Structure constant being the ratio of the speed of the electron in the Bohr atom to the speed of light,

$$137.035\ldots^2 = \frac{c^2}{v_e^2}. \tag{27}$$

also, we know that the Fine Structure constant follows the equation (21) then we reduce formula (27) to,

$$\frac{r_U}{N_e} = 2\pi r_h \alpha. \tag{28}$$

Where we have changed 1/137.035... by the notation $\alpha$ more used in physics to describe the Fine Structure constant. The meaning of this equation would tell us, that the quotient of the distance in meters of Universe's radius between the number of Structural vertices that would hold an electron inside Spacetime is equal to the Bohr diameter multiplied by $\alpha$, as is already known, this last value is equal to the Compton wavelength for an electron.

$$\lambda_{ce} = \frac{h}{m_e c} = 2\pi r_h \alpha. \tag{29}$$

Therefore, we argue that $N_e$ and 137.035... correspond to a determined number of Spacetime's Structural vertices, the first defining the radius of the Universe and the second the Bohr diameter, being $\lambda_{ce}$ known as the Compton electron wavelength, the distance between vertices in meters. Once the distance between vertices has been determined, we can calculate the separation in time, the value of $N_e$ is $3.91 \times 10^{37}$ energy vertices, if we divide the age of the Universe obtained in this study ($3.169 \times 10^{17}$ s) by $N_e$ a result of $8.09 \times 10^{-21}$ s appears, that it's the inverse of the Compton's electron frequency ($t_{ce}$). Thus, $N_e$ is not only defining a distance but also a time, describing both the age and the radius of the Universe. In this way, the speed of light ($c$) can be explained as the relationship between the space and time separation for each vertex,

$$c = \frac{\lambda_{ce}}{t_{ce}}. \tag{30}$$

This interpretation also would indicate a Universal mechanism, since the energy of each vertex decreases with Universe age, the number of vertices necessary to sustain an electron and the radius of the Universe would increase both proportionally, keeping the Compton electron wavelength distance between node and node of the Structure, we are going to try to extend this hypothesis in the next sections.

## 4. Big Bang and entropy. The constants of nature dependent on the age of the Universe

### 4.1. Big Bang

Once we have calculated how the Structure of Spacetime would be quantified, we suggest that the mechanism that triggered the Big Bang could have occurred around this quantum minimum expression, the Compton electron wavelength, taking up the proposed equation for the mass of the Universe $c^2 \times r_U/4G = M_U$ (10) we can substitute $r_U$ for the value of the Compton electron wavelength, obtaining $8.1 \times 10^{14}$ kg as the initial mass at the time of the Big Bang. As previously predicted, the Universe would be made up of a bubble of Spacetime, which weaves structure and creates matter in its path expanding at the speed of light. Knowing that the expansion force is constant at $3.02 \times 10^{43}$ Newtons, we can apply F=ma=mc/t to find the minimum time when the Big Bang occurred as $8.09 \times 10^{-21}$ s just the same time in which we propose the Structure would be quantified.

### 4.2. The strongest fight in the Universe

In the calculations performed, the value of $3.02\times10^{43}$ Newtons constantly appears, being considered the greatest force that can exist in the Universe. As it can be deduced, a black hole is formed when a celestial body reaches this force through internal processes, then it is suggested that in the event horizon of any black hole there is an enormous struggle between the internal force of the black hole and the Universe that surrounds it, in fact, if we calculate the inner force of Sagittarius A, the black hole in the center of our galaxy, with the observational data obtained:

Mass= Approx. 4 million Solar masses.

Radius= Approx. $2.2 \times 10^{10}$ m.

As $Force = Energy/Distance$, we can calculate, $F = (7.15\times10^{53}$ Joules$)/(2.2\times10^{10}$ m$) = 3.2\times10^{43}$ Newton. We can say that when the structure of the Quantum Vacuum breaks down, the energy it contains would remain accumulated inside it, ceasing the separation of space and time defined between vertices, creating a disorder where the constants of Nature do not rule, since as we will postulate in the next section, they would be properties of the same Spacetime Structure.

### 4.3. The constants of nature and the Spacetime structure

The hypothesis of Dirac's Large Numbers introduces the concept to establish a proportionality relationship between the Cosmic age and the Gravitational constant G, [7] with this initial idea, we will do the deductions of some of the main Universal constants obtained from the equations found, as function of the age of the Universe (T):

**Planck constant:**

$$h = E_v T. \tag{31}$$

Where $E_v$, as we seen in equation (19) indicates the energy of a structural vertex and T the age of the Universe, therefore here, $E_v$ is a value that decreases as the Cosmic age increases, keeping h constant. The minimum quantum jump will always be a multiple of this quantity, since the Spacetime texture would be quantized in this value.

**Gravitational constant:**

$$G = \frac{c^3 T}{6M_v}. \tag{32}$$

Where $M_v$ represents the mass of the Quantum Vacuum or Dark energy at a certain Cosmic age, therefore the proportionality is maintained between both values, keeping $G$ constant and indicating that $G$ is a property of relation with the mass inherent to the Spacetime Structure and the age of the Universe.

**Coulomb constant:**

$$K_c = \frac{E_v T c\alpha}{2\pi e^2}. \tag{33}$$

This is the most obvious of all deductions since $K_c$ is kept constant thanks to Planck constant.

As a common factor, the proportional variation between the energy of each vertex and the age of the Universe, would offer the mechanism by which the constants of Nature could be kept at the same value through billions of years. All the equations found seem to suggest that they would arise as properties of the same Spacetime Structure, since they would depend directly on their properties, this will be dealt later with the introduction of Structural Units.

## 5. Beckentein-Hawking's entropy equation, Big Bang and information

Thanks to the development carried out in the 70s by Beckenstein and Stephen Hawking on the physics of black holes, [8] the equation that describes its entropy was established, following the equation,

$$S = \frac{\pi A K_B c^3}{2hG}. \tag{34}$$

Where $A$ is the black hole area and $K_B$ the Boltzmann constant. Also, Stephen Hawking deduced in 1974, that black holes lose energy through a mechanism known as Hawking's radiation and therefore they can evaporate over time. This continuous thermal emission would produce a loss of energy that, according to Hawking, could lead to an explosion at the end of the black hole's life, due to the last acceleration in this emission. In this study, the limit of the evaporation of a black hole will be established in the minimum quantum of Spacetime, therefore, we argue that this could be the Big Bang mechanism, the maximum energy contained in the minimum possible Spacetime. We suggest that the equation for the entropy of a black hole found by Beckenstein and Hawking could serve to describe also the entropy of the Universe, as they would have the same origin. To check if this idea could make sense, calculations will be carried out with the expressions found, first we will equate the Boltzmann and Bekenstein-Hawking equation on entropy,

$$K_B \ln \Omega = \frac{\pi A \; K_B c^3}{2hG}. \tag{35}$$

The term $ln\Omega$ is relative to the number of microstates that the macrostate of the Universe would contain and it is related to its information. We will isolate $ln\Omega$ to try to establish its concrete meaning, mixing the following formulas with (35).

Universe mass $c^2 \times r_U/4G = M_U$ (10).

Planck constant $h = E_v T$ (32).

Universe area

$$A_U = \pi {r_U}^2. \tag{36}$$

Number of Universe Structural/Spacetime vertices

$$\frac{M_U}{m_v} = \; N_U. \tag{37}$$

where $m_v$ is the mass of every Spacetime Structural vertex we can reduce to,

$$\ln \Omega = \frac{2\pi^2 M_U}{m_v} = 2\pi^2 N_U. \tag{38}$$

Thus, we have obtained that the meaning of $\ln \Omega$ is twice $\Pi$ squared the number of vertices of the Spacetime Structure created since the Big Bang ($N_U$), this result relates directly the information contained in the Universe with the Quantum Vacuum, therefore the entropy of the Universe would be equal to,

$$S = \; 2\pi^2 N_U K_B. \tag{39}$$

And if we understand Boltzmann constant as the energy necessary to increase a hydrogen atom one Kelvin degree inside a determined system, the entropy would be defined as the energy necessary to increase the Universe one Kelvin degree, if in each position of the Spacetime quantized Structure or vertex, a hydrogen atom is located.

### 5.1. Differences between the evolutions of the Universe and a Black Hole

From the calculations carried out previously, it could be deduced that Planck constant plays a decisive role, defined as a property derived from the separation in space and time between energy vertices of the Quantum Vacuum Structure, a black hole would be formed when the Planck constant is lost in a region of the Universe or the Spacetime link between Structural vertices is broken. In the same way, we could conjecture that the Big Bang could have happened when the Planck constant was reestablished inside its black hole, this would happen when the energy of a Structural vertex reaches the rest energy of an electron ($E_e = m_e \times c^2$) in its interior, coinciding with the minimum quantum of Structural time and space $8.09 \times 10^{-21}$ s and $2.426 \times 10^{-12}$ m, respectively, since contrary to what would happen in the Universe, disordered vertices increase in energy while decreasing in number,

$$h = \; E_e T. \tag{40}$$

Where $E_e$ represents the energy of a Structural vertex with the rest mass of an electron. In a Universe in continuous expansion the number of vertices of its Structure increases, as well as its entropy/information, while in a black hole the opposite would happen, its entropy decreases as it evaporates reducing $N_x$, following the formula, valid for both:

$$\frac{r_x^2 c^3}{4hG} = \; N_x \tag{41}$$

Where $r_x$ is the Universe or black hole radius and $N_x$ the number of its Spacetime vertices. The information would be linked to the Planck constant, allowing the establishment of the rest of the constants of Nature, therefore in a black hole, although it does not contain information/Universal constants inside, it would retain the ability to reweave it, when the Planck constant appears at the end of its evaporation process at the minimum Spacetime quantum expression. As consequence, Bekenstein-Hawking entropy equation (34), would be describing the Universe or black hole entropy if we change the black hole area by the Universe area. Equation (41) can be compared with (17) deduced in section **2.8.** finding that they are the same.

## 6. Introduction to structural/spacetime units

The Fine Structure constant appears in several equations which characterize phenomena such as a photon emission, the speed of an electron or the connection found in the LCH between a particle's lifetime and its mass, among many others. Once its possible relationship with the Structure of Spacetime has been suggested, we postulate a solution to its meaning, based on a geometric visualization. By virtue of this statements, we propose a new system of units, which we will call Structural or Spacetime Units, where we will establish connections with the numbers Π, Φ or the Golden Ratio and $\alpha$ or the Fine Structure constant, numbers that are constantly found in Nature and our physics.

### 6.1. Relationships between the energies that describes an electron and geometry

The classic equations of known energies which are involved in the electron's movement are the following,

$$kinetic\ energy = \frac{1}{2} m_e v_e^2. \tag{42}$$

$$Electrical\ energy = \frac{k_c e^2}{2r_h}. \tag{43}$$

Where $k_c$ is the Coulomb constant and $r_h$ is the Bohr radius of a hydrogen atom,

$$Minimum\ energy\ \ (Planck\ energy) = \ hf_e. \tag{44}$$

Being $f_e$ the electron frequency,

$$Electron's\ energy = \ m_e c^2. \tag{45}$$

Combining the different equations with the Fine Structure constant, we can find the following relationship.

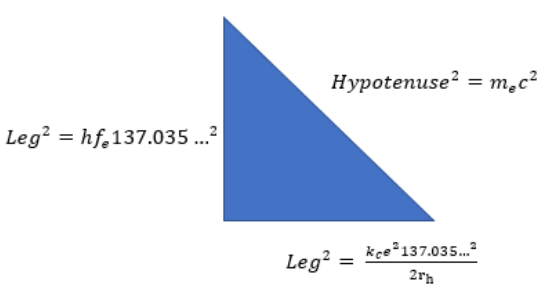


**Figura 2**: If we observe this formula and follow the Pythagorean Theorem while considering that the sides of the triangle (legs and hypotenuse) form the equilibrium of energies associated to a hydrogen atom.

$$m_e c^2 = \ hf_e 137.035\ldots^2 + \frac{k_c e^2 137.035\ldots^2}{2r_h}. \tag{46}$$

Then, we will try to simplify as,

$$m_e c^2 = \frac{2}{\alpha^2}. \tag{47}$$

As the legs formed by the Planck and electrical electron minimum energies are equal, we will give the value 1 for each other, in a similar way that Natural units. Suggested by the relationship between the Golden Ratio ($\varphi$) and the Fine Structure constant that Raji Heyrovska found in 2013, [9] we established the following solution,

$$m_e c^2 = 2\varphi^2 \frac{1}{\alpha^2 \varphi^2}. \tag{48}$$

Therefore, the electron mass and the speed of light (c) are defined in Structural/Spacetime Units as,

$$m_e = 2\varphi^2. \tag{49}$$

$$c = \frac{1}{\varphi\alpha}. \tag{50}$$

### 6.2. Proton mass. Dimensional analysis

Following the geometric reasoning applied to the energies that define a hydrogen atom, this relationship that describes the mass of a proton was found, this time using the area of a square formed by electron's energies,

$$m_p = \frac{hf_e}{2\alpha^2} \times \frac{k_c e^2}{2\alpha^2 r_h}. \tag{51}$$

That is equivalent to,

$$m_p = \frac{m_e^2 c^4.}{4} \tag{52}$$

Performing a dimensional analysis, we obtain the following relationship, kg$= s^4/m^4$. The definition of mass expressed as a relationship between time and space. Then we proceed to apply this definition to energy units in the International System of Units (S.I.), Joule$= (kg \times m^2)/s^2 = s^2/m^2$, according to the dimensional analysis carried out, we will establish the hypothesis that mass and energy are different expressions of the Structure of Spacetime, with mass being Spacetime in four dimensions and energy its expression in two dimensions.

### 6.3. The meaning of E=mc$^2$ in structural units

To continue with the translation to Structural Units, we will stop at the equation found by Einstein, which relates mass and energy,

$$E = mc^2. \tag{53}$$

In this proposed system of units, where mass and energy are different Spacetime expressions, Einstein's equivalence equation, acquires the meaning of being the mathematical expression of the dimensional change that the mass would undergo to become energy and vice versa.

| UNIVERSAL CONSTANT | STRUCTURAL UNIT VALUE | UNITS |
|---|---|---|
| $h$ (Planck constant) | $\frac{2}{\alpha^2}$ | $\frac{time^3}{space^2}$ |
| $K_C$ (Coulomb constant) | $\frac{2}{\alpha^2}$ | $\frac{time^2}{space * charge^2}$ |
| $G$ (Gravitational constant) | $2.293135661 * 10^{-50}$ * | $\frac{space^7}{time^6}$ |
| $K_B$ (Boltzmann constant) | $\frac{2\varphi}{\alpha^3\pi^2}$ * | $\frac{time^3}{space^3}$ |
| $\mu_0$ (Magnetic permittivity) | $8\varphi^2\pi$ | $\frac{time^4}{space^3 * charge^2}$ |
| $\varepsilon_0$ (Electrical permittivity) | $\frac{\alpha^2}{8\pi}$ | $\frac{space * charge^2}{time^2}$ |
| $c$ (speed of light) | $\frac{1}{\varphi\alpha}$ | $\frac{space}{time}$ |
| $m_e$ (electron rest mass) | $\frac{4\varphi^2}{\alpha^2}$ * | $\frac{time^4}{space^4}$ |
| $m_e$ (electron mass) | $2\varphi^2$ | $\frac{time^4}{space^4}$ |
| $m_p$ (proton mass) | $\frac{1}{(\cos\beta)^4\alpha^4}$ * | $\frac{time^4}{space^4}$ |
| $r_h$ (Bohr radius) | $\frac{1}{4\varphi\pi}$ | $space$ |
| $e^2$ (electrical charge squared) | $\frac{1}{2\varphi\pi}$ | $charge^2$ |
| $f_e$ (electron frequency) | 1 | $\frac{1}{time}$ |
| $\lambda_{ce}$ (Compton electron wavelength) | $\frac{\alpha}{2\varphi}$ | $space$ |
| $v_e$ (electron speed) | $\frac{1}{\varphi}$ | $\frac{space}{time}$ |
| $R_h$ (Rydberg constant) | $\alpha\varphi$ | $\frac{1}{space}$ |
| $r_e$ (electron classic radius) | $\frac{\alpha^2}{4\varphi\pi}$ | $space$ |

**Table 2.** Most of the Natural constants that appear are expressed as functions of the numbers $\pi$, $\phi$ and the Fine Structure constant $\alpha$, showing how they would be closely related to each other. The meters, seconds and kg of our S.I. have also been changed for units of distance and time in similarity with the Spacetime's Structure described in previous sections. As example, if $2/\alpha^2 = hf_e$ and $f_e$ is equal to the electron speed ($c\alpha$) divided by the Bohr diameter ($2\pi r_h$), we can get by substitution that $r_h = 1/4\varphi\pi$. (The $\times$ indicated values that will be explained in detail in next sections).

## 6.4. Conversion of natural constants from the International System (S.I.) to Structural Units (S.U.)

With the data provided in the previous sections, the conversion of the Natural constants that define our physics to S.U. can be started using the known equations describing them and Lederman‘s idea about the same calculated value of the Fine Structure constant whatever the unit's system established to describe physics phenomena. Also, we want to highlight that the equivalence between two different unit's systems as S.I. and the proposed S.U. could be checked in two ways.

1. By the coincidence in the values of dimensionless numbers as Dirac's Large Numbers or Eddington number as examples, because the proportionality relationship would be preserved independent of the system of units.

2. The dimensional analysis that would allow to change from one system of units to another.

For this purpose, the following table has been calculated.

Next, we will try to verify the equivalence of the values presented through dimensional analysis, as examples we will start with the Bohr radius and the speed of light:

**Bohr radius:** Having defined the distance between vertices of the Spacetime Structure as the Compton electron wavelength, we can calculate the equivalence of this distance in Structural Units through the formula obtained,

$$\lambda_{ce} = \frac{\alpha}{2\varphi} = 0.00225\ldots \tag{54}$$

Being the Bohr radius in Structural Units,

$$r_h = \frac{1}{4\varphi\pi} = 0.04918\ldots \tag{55}$$

We proceed to divide the distance of the Bohr radius by the separation between Structural vertices in S.U. 0.04918/0.00225= 21.8... this result being the number of vertices that the Bohr radius occupies in Spacetime Structure, we can multiply by the distance between vertices in meters, the Compton electron wavelength, 21.8... Structural vertices$\times$2.426... $\times 10^{-12}$ m obtaining 5.291772$\times 10^{-11}$ m and equal to the CODATA Bohr radius.

**Speed of light:** In S.U. we have defined $c$ with the formula, $c = 1/\varphi\alpha$ (50), above we have extracted the distance between Structural vertices, but we would need to know the time in S.U. as when we speak of one Structural Unit, we are referring to both concepts together. Then starting from the Compton wavelength of an electron in S.U. we will calculate the inverse of its frequency obtaining,

$$t_{ce} = \frac{\alpha^2}{2}. \tag{56}$$

And now we can transform c from S.U. to S.I. applying a dimensional analysis with the corresponding equivalences between space and time,

$$\frac{1}{\varphi\alpha}\frac{distance}{time} \times \frac{2.426\ldots \times 10^{-12}\ meters}{0.00225\ldots\ distance} \times \frac{0.0000266\ldots\ time}{8.09\ldots \times 10^{-21} seconds} = 299792458\ \frac{meters}{seconds} \tag{57}$$

## 6.5. Dimensionless numbers. Dirac's/Eddington large numbers hypothesis

The dimensionless numbers constitute an excellent testing ground for the calculations and ideas previously proposed, since regardless of the system of units chosen, if the values of the numbers they represent are correct, they will yield the same result. As it is explained in John D. Barrow's book in chapters 5 and 6, [10] Eddington and Dirac realized about the importance that could have the proportional relationships between Natural constants that produce dimensionless numbers, in fact, one of the most important of this numbers were calculated by Eddington, bearing its name in his honour, it describes the number of total protons in the Universe or $N_{Edd}$, being approximately $10^{80}$. According to this study, once established the Universe mass equation, we could express $N_{Edd}$ as:

$$\frac{c^2 r_U}{4Gm_p} = N_{Edd}. \tag{58}$$

Where $m_p$ is the proton mass, if we do the calculations with S.I. values ($r_U = 9.49\ldots \times 10^25$ m) we obtain 1.91... $\times 10^{79}$ protons, but we can do the calculations using Structural Units with the following values:
$c^2 = 1/(\varphi\alpha)^2$ space$^2$/time$^2$.

$r_U = 9.49\ldots \times 10^{25} m \times 2.426\ldots \times 10^{-12}$m= 3.91... $\times 10^{37}$ vertices $\times$0.00225... distance between each node in S.U.= 8.79... $\times 10^{34}$ space of Universe radius in S.U.

$G = 2.293135661 \times 10^{-50}$ space$^7$/time$^6$.

$m_p$= 137.8489145$^4$ time$^4$/space$^4$. $\times$ decimals added to the mass of the proton will be explained in section 7.4.

We get the same result $N_{Edd} = 1.91\ldots \times 10^{79}$ protons. This number would not exactly be the number of protons in the Universe, since it would include all the mass corresponding to the equivalent energy created since the Big Bang, (Spacetime Structure + matter), but as we will also see, it would fit the hypothesis of Dirac's Large Numbers, in this way. Then, motivated by Eddington's ideas, Dirac found the following relationships:

$N_1$= Universe radius/electron classic radius= $10^{40}$.

$N_2$= electromagnetic to gravitational force ratio between proton and electron= $10^{40}$.

So, Dirac argued that there must be a simple relationship between these numbers and the Eddington number as follows, being X an integer number,

$$N_1 N_2 = X N_{Edd}. \tag{59}$$

Now we are going to translate these thoughts, including the proposed equation for the mass of the Universe,

$$N_1 = \frac{r_U}{r_e} = \frac{r_U m_e}{k_c e^2}c^2. \tag{60}$$

$$N_2 = \frac{Electrical\ force}{Gravity\ force} = \frac{k_c e^2}{G m_p m_e}. \quad (61)$$

$$N_{Edd} = \frac{M_U}{m_p} = \frac{c^2 r_U}{4 G m_p}. \quad (62)$$

$$N_1 N_2 = 4 N_{Edd}. \quad (63)$$

Finding that this proportional relationship between the Natural constants involved could be maintained, regardless of the Cosmic age, since the *Eddington number* would vary according to the radius of the Universe. We could also substitute the values of the Natural constants from S.I. to S.U., obtaining the same adimensional numbers.

## 7. Euclidean and non-Euclidean spacetime

Once we have obtained the values in S.U. for the electron and proton mass,

$$m_e = \mathbf{2}\varphi^2. \quad (64)$$

$$m_p = \frac{m_e^2}{4} c^4. \quad (65)$$

We can calculate the known relation between the mass of the proton and the electron in S.U. finding a different value, instead of 1836.152673...

$$\frac{m_p}{m_e} = \frac{137.035999206^4}{2\varphi^2} = 67349349.74 \quad (66)$$

To find a similar value to 1836.152673 we should divide formula (66) by $2\alpha^2$ obtaining 1793.222047..., these two differences between S.I. and S.U. raised two questions:

1. Why does a factor of $\mathbf{2}/\alpha^{\mathbf{2}}$ difference appear in the mass of the electron?

In S.U. mass and energy are geometrically defined as 4D and 2D representations of Spacetime, respectively. The mass of the proton would be a four-dimensional structure, while the electron, as calculations in S.U. suggest, is defined as a two-dimensional spacetime structure or energy. This indicate that the mass in kg equivalent to the energy contained in the electron would be $m_e\alpha^2/2$ kg as we can do the mathematical extrapolation between mass and energy, but we should know its concrete spacetime/dimensional configuration to establish its correct value. This calculation leads directly to the origin of the electric charge, the electron being defined as a photon with enough energy to produce electromagnetism due to the internal shift of the proton in the emission/reception process. This premise would explain why two particles as different as the proton and the electron have the same electric charge, because the electric charge would be the product of an event and not an inherent particle property. Therefore, being the electron a 2D structure, its rest mass only would have a mathematical sense as mass, only would correspond to a 4D structure, being the reason for the discrepancy between S.I. and S.U.

2. What could a distortion of $m_p/m_e$ be due to? In the process of carrying out the proposed calculations, on page 46 of John D. Barrow's book on Natural constants, we find another pure number called $\alpha_G$, [10]

$$\alpha_G = \frac{G m_p^2}{hc}. \quad (67)$$

In Structural Units the mass of the proton is $1/\alpha^4 time^4/space^4$, which geometrically speaking would be a cube in four dimensions or tesseract with $1/\alpha$ vertices of Spacetime per face side. Performing the calculations in equation (67) a variation of approximately 95.37 % appeared between the S.I. and S.U. results, we suggest that this difference could be due to the fact, that the Spacetime Structure is bent by the energy contained in the proton. Therefore, the Structural Units found that adjust to the exact values of $\pi$, $\phi$ and $\alpha$ would be defining the Structure of the Quantum Vacuum without any curvature as it would be a Euclidean Spacetime, which becomes non-Euclidean, by the presence of a proton, entering at this point directly in the calculations of relativity theory and defining the border with classical physics. In the next section, we will try to delve into this idea.

### 7.1. Calculation of the spacetime angle bended by a proton

First, we will use the proton electron mass ratio $(m_p/m_e)$ to calculate the correction between Structural Units and our International System of Units, as we know, using 2018 CODATA recommended values, [11]

$m_p/m_e$= 1836.152673,

while in Structural Units,

$m_p/m_e$= 1793.222047,

Where $m_p = 137.035999206^4$ and $m_e = 2\times\varphi^2 \times 2 \times 137.035999206^2$ using the latest Fine Structure constant experimental value measured in 2020 [12]. We are going to suppose that this difference is due to the Spacetime bending described in relativity and that in proton presence the Spacetime Structure changes from a Euclidean to a non-Euclidean geometry. As non-Euclidean geometry calculations are out of our knowledge, we are going to do the approximation to a Pythagoras Theorem following,

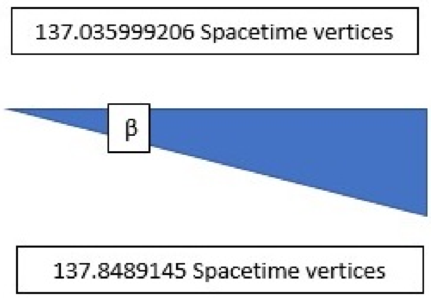


**Figura 3**: If the Fine Structure constant is defining one side of the proton tesseract shape, this side should experiment a spatial dilation, due to the Spacetime flexibility.

As consequence, the proton mass in Structural Units is equal to 137.84891454 instead 137.0359992064 because in S.U.,

$$\frac{m_p}{m_e} = \frac{137.8489145^4}{2 \times \varphi^2 \times 2 \times 137.035999206^2} = 1836.152673. \tag{68}$$

Therefore, we can calculate the angle $\beta$ as the approximation to the Spacetime curvature due to the proton's presence as follows:

$$\cos\beta = \frac{137.035999206}{137.8489145} = 0.9941028. \tag{69}$$

Being,

$$\cos^{-1} 0.994102853 = \beta = 6.22547165 \; degrees. \tag{70}$$

## 7.2. The conversion of Planck constant from S.U. to S.I.

In section 6.4. we translated Bohr radius and the speed of light from Structural Units to International Units, now we will try to do the same with the Planck constant. From Table 2, deduced using fundamental physics equations, Planck constant value is equal to $2/\alpha^2 time^3/space^2$. As we argued, the separation in space and time between structural vertices would be equal to the electron Compton wavelength and time, in order to check calculations, we will take the following equivalence between S.I. and S.U. values of this minimum quanta:

**S.I.**

$$\lambda_{ce} = \frac{\mathrm{h}}{\mathrm{m_e c}} = 2.4263102 * 10^{-12} \; meters.$$

$$t_{ce} = \frac{\lambda_{ce}}{c} = 8.0932996 * 10^{-21} \; seconds.$$

**S.U.**

$$\lambda_{ce} = \frac{\alpha}{2\varphi} = 2.2550059 * 10^{-3} \; space.$$

$$t_{ce} = \frac{\alpha^2}{2} = 2.6625677 * 10^{-5} \; time.$$

Then, we can proceed with the unit's system change:

$$h = \frac{2}{\alpha^2}\frac{time^3}{space^2} \times \frac{\left(8.09\ldots \times 10^{-21}\right)^3 \; seconds^3}{(0.0000266\ldots)^3 time^3} \times \frac{(0.00225\ldots)^2 \, space^2}{\left(2.42\ldots \times 10^{-12}\right)^2 meters^2} = 9.1112306 \times 10^{-25} \; \frac{seconds^3}{meters^2}. \tag{71}$$

As we seen, in equation (52) about proton mass $m_p = (m_e^2 c^4/4$ we found a $(2/\alpha^2)$ factor difference for every electron rest mass. As it is squared, we are going to reestablish the S.I. unit kg dividing our result for $(2/\alpha^2)^2$ and applying the equivalence kg = seconds$^4$/meters$^4$.

$$\frac{9.1112306 \times 10^{-25}}{(2/\alpha^2)^2} = 6.4591945 \times 10^{-34} \, \frac{s^3}{m^2} = \frac{s^4 \times m^2}{m^4 \times s} = \frac{kg \times m^2}{s}. \tag{72}$$

This is close to the Planck constant S.I. value, but we also have calculated that the proton would bends a certain angle ($\beta$= 6.22547165 degrees) the Spacetime Structure, then we are going to consider that this correction is needed every time the unit kg is involved in the translation, therefore:

$$\frac{6.4591945 \times 10^{-34}}{(\cos 6.22547165)^4} = 6.6138308 \times 10^{-34} \; \frac{kg \times m^2}{s}. \tag{73}$$

Where $\cos 6.225447165$ is elevated to the fourth, to preserve the four-dimensional nature of kg or mass. Comparing this calculated value with the experimental Planck constant CODATA:

$$\frac{6.6138308 \times 10^{-34}}{6.62607015 \times 10^{-34}} = 0.9981528. \tag{74}$$

A 99.81528 % approximation is achieved. We argue that the Pythagoras theorem is good but not perfect to calculate the Spacetime angle bended by a proton, because the real geometry to apply is non-Euclidean. If this assumption were true, this slight difference would have to be repeated in other translations.

### 7.3. The Gravitational constant translation

In order to obtain the value of the Gravitational constant in Structural Units and translate it to S.I., we are going to use different equations, some well-known and others presented in this study. The formula about Universe mass can be expressed as $(c^2 r_U)/4G = M_U$ (10) if we change the Universe radius ($r_U$) by the Compton electron wavelength or the minimum Spacetime quanta, we get a result for Universe mass about $8.168388092 \times 10^{14}$ kg and if we divide by proton mass, we can get the Universe proton number equivalence at this radius ($N_p$)

$$\frac{M_U}{m_p} = N_p = 4.8835831 \times 10^{41}\ protons. \tag{75}$$

Now, with $N_p$ value we can calculate $M_U$ in Structural Units, as we know that in S.U. proton mass is equal to $137.8489145^4 time^4/space^4$, then $M_U = N_p \times m_p = 1.7634046 \times 10^{50} time^4/space^4$ as Universe mass in S.U. therefore we can clear $G$ from the equation (10) in S.U. obtaining $G = 2.2931356 \times 10^{-50} space^7/time^6$. In previous section, we found a distortion about 95.375 % between the values of the adimensional number $\alpha_G$.

$$\alpha_G = \frac{G m_p^2}{hc}. \tag{76}$$

Substituting the values in S.I. but also in S.U. we get the same result for the adimensional number $\alpha_G = 9.39961 \times 10^{-40}$, showing that the corrections introduced due to the proton Spacetime bending seems to be correct. From these calculations, we have obtained the value of G in S.U., therefore we are going to try to translate G to our S.I. to check its equivalence:

$$G = 2.29313 \times 10^{-50} \frac{space^7}{time^6} \times \frac{(2.426 \times 10^{-12})^7\ m^7}{(0.00225)^7\ space^7} \times \frac{(0.0000266)^6\ time^6}{(8.09 \times 10^{-21})^6\ seconds^6} = 4.85367 \times 10^{-20}\ \frac{m^7}{s^6}. \tag{77}$$

As we did with Planck constant, we will use the same factor to re-establish the unit of kg:

$$4.85367 \times 10^{-20} \times (2/\alpha^2)^2 = 6.846504 \times 10^{-11}\ \frac{m^4 \times m^3}{s^4 \times s^2} = \frac{m^3}{kg \times s^2}. \tag{78}$$

Note that to return to kg, now the factor is multiplying instead dividing as in the Planck constant transformation, because the unit kg is in the denominator. To finish the translation to S.I. we are going to apply the Spacetime bending correction also multiplying:

$$6.846504 \times 10^{-11} \times (\cos 6.22547165)^4 = 6.686428 \times 10^{-11}\ \frac{m^3}{kg \times s^2}. \tag{79}$$

Then, $6.6743 \times 10^{-11}/6.686428 \times 10^{-11} = 0.998186$, obtaining a very similar value to the Planck constant translation difference, equal to 0.9981529.

### 7.4. The proton mass translation

Another example we are going to try to calculate is the conversion of the proton mass from S.U. to S.I., following the same argument explained for the Planck and Gravitational constants, as $m_p = 1/((\cos\beta)^4 \alpha^4)$ being $\beta$ the Spacetime angle bended by a proton we can calculate:

$$m_p = \frac{1}{(\cos\beta)^4 \alpha^4} \frac{time^4}{space^4} \times \frac{\left(8.09 \times 10^{-21}\right)^4 seconds^4}{(0.0000266)^4\ time^4} \times \frac{(0.00225)^4 space^4}{\left(2.426 \times 10^{-12}\right)^4\ meters^4} = 2.2999519 \times 10^{-18}\ \frac{s^4}{m^4} \tag{80}$$

Applying the kg transformation,

$$\frac{2.2999519 \times 10^{-18}}{(2/\alpha^2)^2} = 1.6304973^{-27} \frac{seconds^4}{meters^4}. \tag{81}$$

And at last, the $\beta$ correction due to proton spacetime bending angle:

$$\frac{1.6304987 \times 10^{-27}}{cos 6.22547165)^4} = 1.66953382 \times 10^{-27} kg \tag{82}$$

That compared with the CODATA proton mass value ($1.6726219 \times 10^{-27}$ kg) gives an approximation about 99.81527 % to S.I., very similar to the Planck and the Gravitational constants difference in translation.

### 7.5. The Coulomb constant translation

In Structural Units, the Coulomb constant is equal to $2/\alpha^2 time^2/(space \times charge^2)$ and applying the same reasoning:

$$\frac{2}{\alpha^2}\ \frac{time^2}{space \times charge^2} \times \frac{\left(8.09 \times 10^{-21}\right)^2\ second^2}{(0.0000266)^2\ time^2} \times \frac{0.0225\ space}{2.426 \times 10^{-12}\ meter} \times \frac{0.0983\ charge^2}{2.566 \times 10^{-38}\ Coulomb^2} = 1.2358 \times 10^{19}\ \frac{s^2}{m \times C^2} \tag{83}$$

Applying the kg transformation,

$$K_c = \frac{1\ 1.2358402 \times 10^{19}}{(2/\alpha^2)^2}\ \frac{s^4 \times m^3}{m^4 \times s^2 \times C^2} = \frac{kg \times m^3}{s^2 \times C^2}. \tag{84}$$

Applying the $\beta$ correction:

$$\frac{8761201265}{(\cos 6.22547165)^4} = 8970948763\ \frac{kg \times m^3}{s^2 \times C^2}. \quad (85)$$

And $(S.I.)$ 8987551793/$(S.U.)$ 8970956894= 0.9981526, confirming a value about 99.8152 % as the proposed by the Euclidean approximation to a non-Euclidean geometry.

### 7.6. Hybrid equations

Once calculated the equivalence between Structural and International Units, it can be deduced equations that mix both units systems in the same expression, that we are going to call hybrid equations, where Natural constants and the pure numbers $\pi$, $\phi$ and $\alpha$ can be mixed. Here are some examples, where the equation terms are ordered to produce adimensional numbers,

$$\varphi^2\pi\alpha^3(\cos\beta)^4 = \frac{h}{8r_h c m_p}. \quad (86)$$

Note that for the dimensional analysis of the equation (86) can be used S.I. then the equation offers an exact solution.

$$2\varphi^2\pi\alpha(\cos\beta)^4 = \frac{h}{k_c e^2 m_e c^3}. \quad (87)$$

In this formula, to fit the units we must use Table 2 (kg= seconds$^4/m^4$, then we find that the result is approximated by 99.815 % due to the Euclidean/non-Euclidean extrapolation done. This combination also would allow mathematical expressions for relationships that currently only have been found by experimental data, as the proton-electron mass ratio:

$$\frac{m_p}{m_e} = \frac{1}{4\varphi^2\alpha^2(\cos\beta)^4}. \quad (88)$$

And finally, we write this hybrid formula deduced from the geometrical combination between the energy equations that describes an electron in classical physics, where the CODATA values of seven Natural constants join to obtain $\varphi$,

$$\varphi = \frac{\frac{\sqrt{\frac{hf_e}{2}}}{2} + \sqrt{\frac{5m_e\alpha^2c^2}{16}}}{\sqrt{\frac{K_c e^2}{4r_h}}}. \quad (89)$$

To calculate $f_e$ we divided the electron speed by the half of the Bohr diameter,

$$f_e = \frac{c\alpha}{4\pi r_h}. \quad (90)$$

## 8. Speed of sound, viscosity and Black Hole Physics

In a recent study, an unexpected relationship has been found between two dimensionless fundamental physical constants and the speed of sound, [13] they are the Fine Structure constant and the ratio between the mass of the proton and the electron $m_p/m_e$. As a consequence, a new physical constant emerges from the relationship between the maximum speeds of sound and light. In another paper published by some of the same authors, it has been found a value for the minimal kinematic viscosity of fluids with an equation also involving $m_p/m_e$ [14] We will try to establish the close relationship between both papers, using the idea given by the authors about the connection to the bound found by Kovtun, Son and Starinets from black hole physics, between the fluid viscosity ($\eta$) and entropy ($S$) in strongly interacting field theories, where $h$ is the Planck and $K_B$ the Boltzmann constants, respectively, [15]

$$\frac{\eta}{S} = \frac{h}{8\pi^2 K_B}. \quad (91)$$

As a result, it is obtained an equation that mix the minimum quantum viscosity ($v_m$), the maximum speed of sound ($v_u$), the Fine Structure constant ($\alpha$), the fluid viscosity ($\eta$) and Entropy ($S$) terms,

$$\frac{\eta}{S} = \frac{\pi^2\sqrt{8}\, v_m\alpha}{2v_u}. \quad (92)$$

This relationship between macro and quantum worlds, would allow us to characterize the same Spacetime Structure as a perfect fluid, using Hawking-Bekenstein black hole entropy equation as link,

$$S = \frac{\pi A K_B c^3}{2hG}. \quad (93)$$

Mixing Structural Units with this latest research.

### 8.1. Speed of sound

The maximum limit of the speed of sound ($v_u$) has been established using the following formula, [13]

$$\frac{v_u}{c} = \alpha\sqrt{\left(\frac{m_e}{2m_p}\right)}. \quad (94)$$

This limit would correspond to a medium formed by metallic atomic hydrogen, but the speed of sound in other atomic media (v) can be derived from the equation

$$v = \frac{v_u}{A^{\frac{1}{2}}} \quad (95)$$

Where A is the atomic mass. First, we will substitute the formula for the mass of the proton $m_p = \frac{m_e^2}{4}c^4$, in (94) then we can simplify to,

$$v_u^2 = \frac{2 \times \alpha^2}{m_e c^2}. \quad (96)$$

If we perform a dimensional analysis of the equation (96) in S.I. we will see that it is not compatible with the result of a velocity squared, but if we apply S.U. where $kg = s^4/m^4$. we will obtain the correct units $m^2/s^2$. The discovery of this maximum limit for the speed of sound, also introduces another dimensionless constant, as it's noted by the authors whose value is equal to $v_u/c$ and very similar to the Fine Structure constant first definition $v_e/c$. This analogous expression could point to a close relationship between photon and phonon emission/reception process, as two dimensionless fundamental constants, commonly used in quantum mechanics, how $\alpha$ and $m_p/m_e$ are also describing the speed of sound. We are going to call $\psi$, this $v_u/c$ ratio and if the Fine Structure constant follows the known equation (21), $\psi$ can be written as,

$$\psi = \frac{v_u}{c} = \frac{\alpha^2}{ec\sqrt{\left(\frac{K_c}{2r_h}\right)}}. \tag{97}$$

Being $r_h$ the Bohr radius. Then the equation,

$$\frac{2}{\alpha^2} = \frac{m_e c^2}{hf_e}. \tag{98}$$

Derived from quantum mechanics, [16] where $f_e$ is the electron frequency, would have its equivalent equation for sound in the following formula,

$$2(\frac{c}{v_u})^2 = \frac{m_e c^2}{hf_p}. \tag{99}$$

Where $f_p$ is the phonelectron frequency, we introduce this concept to explain what the frequency of the phonon would be to produce the maximum speed of sound. Equation (96) can be ordered to obtain,

$$\frac{m_e v_u^2}{2} = \frac{\alpha^2}{c^2}. \tag{100}$$

This equality describes the kinetic energy of a phonelectron transferred to the atom. We can check its equivalence with the value obtained isolating $f_p$ in eq. (99).

$$f_p = \frac{m_e c^2}{2h(\frac{c}{v_u})^2} = 8.94 \times 10^{11} \quad s^{-1}. \tag{101}$$

$$hf_p = \frac{m_e v_u^2}{2} = \frac{\alpha^2}{c^2}. \tag{102}$$

As consequence, is proposed that if the photon occupies a certain area of Spacetime, the phonelectron has an equal behavior, it can also be verified that the resulting units are $s^2/m^2$ equivalent to Joules in S.I. By means of the Compton wavelength equation for a phonelectron, we can also associate a mass ($m_{ph}$) with it, although its configuration may be two-dimensional, Einstein's equation allows us to make the mathematical transformation,

$$m_{ph} = \frac{h}{\lambda_p c}. \tag{103}$$

Then:

$$hf_p = \frac{m_e v_u^2}{2} = m_{ph} c^2. \tag{104}$$

We have interpreted this equality because the phonelectron, like the photon, moves at the speed of light in the Spacetime between atoms and that the observed delay, which determines the speed of sound, occurs because the time between emission/reception process of each of the atoms that make up the medium. The new dimensionless constant determined by the maximum speed of sound, could also be defined by the relationship between the masses of the electron and the phonelectron,

$$2(\frac{c}{v_u})^2 = \frac{m_e}{m_{ph}}. \tag{105}$$

from the combination of formulas, the following expression can also be found relating the masses of the proton, the electron and the phonelectron, by means of the Fine Structure constant, as photons and phonons emission/reception process would have a common proton origin.

$$m_p = \frac{m_e^2 \times \alpha^2}{4m_{ph}}. \tag{106}$$

### 8.2. Minimal Quantum viscosity

A few months earlier, Trachenko and Brazkhin, had published an article relating the minimum quantum viscosity ($v_m$), also using fundamental physical constants [14].

$$v_m = \frac{h}{8 \times \pi^2 \sqrt{m_e m}}. \tag{107}$$

Where $m$ is the mass of the molecule set by the nucleon mass, we will use the proton mass $m_p$ and the concepts introduced in this work to obtain an equation, that directly connects $v_{mp}$, or the minimum quantum viscosity for a proton with the maximum speed of sound,

$$v_{mp} = \frac{v_u r_h}{\sqrt{8}\pi}. \tag{108}$$

Being $r_h$ the Bohr radius and $v_u$ the maximum speed of sound, demonstrating again a remarkably close relationship between photons and phonons, determined by its process of emission/reception inside the atom. This paper also refers to a universal ratio found and which we will discuss in the next section to try to connect the properties of the atom with those of the Spacetime Structure.

### 8.3. Black Hole Physics

In 2004 Kovtun, Son and Starinets (KSS) found a universal value between the viscosity of a fluid and volume density of entropy, [15] which can be applied to a wide class of thermal quantum field theories,

$$\frac{\eta}{S} = \frac{h}{8\pi^2 K_B}. \tag{109}$$

Where $\eta$ is the fluid shear viscosity and S the volum density of entropy. Derived from calculations on the thermodynamics of black holes suggested by Hawking and Bekenstein, it is found that this solution can be extended to the field of hydrodynamics, then we will try to check if Spacetime Structure could be described as a perfect fluid using this equation, due to the analogies before described with black holes. The first thing we will do, it is to relate the two previous sections to find an equation that includes these new concepts, defined by some Natural constants,

$$\frac{\eta}{S} = \frac{\pi^2\alpha\sqrt{8}}{2v_u}v_m. \tag{110}$$

The concepts presented in these three papers seem to be intricately linked by describing a value that defines a common lower limit in quantum fields equal to $6.0783\ldots\times10^{-13}$ kelvin*second. To try to decipher the meaning of this strange unit's result, we will transform the temperature units (Kelvin) following the reasoning presented for the Structural Units, where the properties of the Universe can be described exclusively by Spacetime relationships. Therefore, we will translate Kelvin to meter/second since the temperature would be describing the speed at which the atoms move inside a system. Thus, the units of this lower limit are in meters, a distance, surprisingly finding that $6.0783\ldots\times10^{-13}$ meters is a value approximately 4 times smaller than the Compton wavelength of an electron, the value suggested in this study in which the Spacetime would be quantified,

$$\frac{\eta}{S} = \frac{h}{8\pi^2 K_B} = \frac{h}{4m_e c}. \tag{111}$$

We could perform a dimensional analysis of the Boltzmann constant with the transformation to Structural Units where,

$$K_B = \frac{\varphi}{\alpha\times\pi^2}\times\frac{2}{\alpha^2}\,\frac{time^3}{space^3}. \tag{112}$$

(We introduce the term $2/\alpha^2$ because it is found this discrepancy between electron mass in S.U. and S.I.), getting that the result for $\eta/S$ is a distance. Once proposed the possible relationship with the Structure of Spacetime, we can match the equation (109) found by KSS, with the one deduced in this study (39) on the entropy of the Universe,

$$S = \frac{8\pi^2 K_B \eta}{h} = 2\pi^2 N_U K_B. \tag{113}$$

And simplifying we can arrive to,

$$N_u = \frac{4\eta}{h}. \tag{114}$$

In this equation, the number of energy vertices that forms the Spacetime Structure ($N_u$) is defined by the relationship between the total shear viscosity of the Structure ($\eta$) and the Planck constant, we could say that h is the minimum quantum unit of the Spacetime shear viscosity and that the Universe is defined by the sum of Planck's constants that make it up increasing over time. To define the Gravitational constant as a function of the Structure's shear viscosity, this expression can also be isolated,

$$G = \frac{c^3 r_U^2}{16\eta}. \tag{115}$$

As the Universe radius increases ($r_U$), the Structure shear viscosity ($\eta$) would increase proportionally, keeping $G$ constant.

### 8.4. Calculation of the vacuum density from the shear viscosity

This study begins with the value of the Vacuum density measured by the Planck satellite, with the reasoning followed, we will try to calculate this same density to check its validity. From the combination of equations, some known, and others set forth in this writing, we can obtain three expressions.

1. The force exerted on the Spacetime Structure that will depend on the energy contained in the Universe radius as Force= Energy/Distance.

$$F = \frac{M_U c^2}{r_U}. \tag{116}$$

2. The shear viscosity of the Structure as function of the force.

$$\eta_U = \frac{F r_U^2}{4c}. \tag{117}$$

3. The total density of the Universe as a function of the shear viscosity of the Structure ($\eta_U$).

$$\delta_u = \frac{3\eta_U}{\pi c r_U^4}. \tag{118}$$

Doing the calculations, we obtain $8.94\times10^{-27}$ kg/m$^3$, as the Vacuum density would remain at a value of 2/3 the total Universe density, the result is equal to that measured by the Planck satellite $\delta_v = 5.96\times10^{-27}$ kg/m$^3$. These calculations could be extended to any celestial body, as we can calculate the force exerted on the Structure, the resulting shear viscosity and finally its total density, in the case of the Earth with a mass of $5.97\times10^{24}$ kg and a radius about 6378000 m we obtain 5500 kg/m$^3$ as its total density, following these three equations.

### 8.5. Universe entropy and the proton/electron mass ratio

Equation (111)

$$\frac{\eta}{S} = \frac{h}{8\pi^2 K_B} = \frac{h}{4m_e c}. \quad (119)$$

Would allow us to access to new expressions, that describe the equivalent masses of the proton and the electron as function of the Boltzmann constant as the following.

$$m_e = \frac{2\pi^2 k_B}{c}. \quad (120)$$

$$m_p = \pi^4 k_B^2 c^2. \quad (121)$$

$$\frac{m_p}{m_e} = \frac{\pi^2 k_B c^3}{2}. \quad (122)$$

It can be verified that the resulting units are equivalent to kg= $seconds^4/meters^4$. This deep connection found between the Natural constants, would allow us to describe properties as different as the entropy of the Universe and the proton/electron mass ratio within the same equation.

$$S = \frac{\pi^2 K_B c^3}{2hG\Lambda} = \frac{m_p}{m_e G h\Lambda}. \quad (123)$$

Here, the Cosmological constant ($\Lambda$) is equivalent to $1/r_U^2$, where $r_U$ is the radius of the Universe.

### 8.6. The Boltzmann constant translation

In previous section 7, we have revised the compatibility of the values of some Natural constants between our International Units System and Structural Units, but now the incorporation of the link found by Kovtun, Son and Starinets, would allow us to compare if the same reasoning presented here is compatible with this different and independent paper. Then, we will try to translate the Boltzmann constant to S.U. and then return it again to S.I. First, we will pick up equation (120) $m_e = \frac{2\pi^2 k_B}{c}$ incorporating the Structural Unit values from every Natural constant exposed in Table 2, isolating $K_B$ and translating the equation to S.U.

$$K_B = \frac{m_e \times c}{2\times\pi^2} = \frac{2\times\varphi}{\pi^2\times\alpha^3} = 843767.1956\ \frac{time^3}{space^3}. \quad (124)$$

Once we have the Boltzmann constant in Structural Units, we can proceed with the translation using the Spacetime quantization proposed for the others Natural constants,

$$K_B = \frac{2\times\varphi}{\pi^2\times\alpha^3}\ \frac{time^3}{space^3} \times \frac{\left(8.09\times10^{-21}\right)^3\ s^3}{(0.0000266)^3\ time^3} \times \frac{(0.00225)^3\ space^3}{\left(2.426\times10^{-12}\right)^3\ meters^3} \times \frac{1}{(2/\alpha^2)^2} = 1.3486614\times10^{-23}\ \frac{kg\times m^2}{s^2\times K} \quad (125)$$

Applying $\beta$ correction

$$\frac{1.3486614\times10^{-23}}{(\cos 6.22547165)^4} = 1.38094902\times10^{-23}\ \frac{kg\times m^2}{s^2\times K}. \quad (126)$$

And comparing with the CODATA Boltzmann constant value,

$$\frac{1.38064852\times10^{-23}}{1.38094902\times10^{-23}}\times100 = 99.97823\,\%. \quad (127)$$

We obtain a very accurate approach in the translation to S.I., but different from the 99.81526 % value attributed to the Pythagoras theorem extrapolation to a non-Euclidean geometry, we are going to try to explain. Returning to equation (110) $\eta/S = h/8\pi^2 K_B = h/4m_e c$. In S.U. we interpreted this lowest bound on the ratio $\eta/S$, as the distance between energy vertices of the Spacetime Structure, this distance is coincidence with the proposed in this study and equal to the Compton electron wavelength ($\lambda_{ce}$), also we noted that doing the calculations with the CODATA values a small difference is obtained,

$$\frac{h}{8\pi^2 K_B} = 6.07831236\times10^{-13}\ K\times s = m. \quad (128)$$

$$\frac{h}{4m_e c} = 6.065775598\times10^{-13}\ m. \quad (129)$$

Dividing by 4 to find $\lambda_{ce}$ and applying the Spacetime bending reasoning, where the slight difference is due to the angle Structural change,

$$\frac{\lambda_{ce} = 2.426310239\times10^{-12}\ m}{\lambda_{ce}^{‘} = 2.431324944\times10^{-12}\ m} = \cos\omega = 0.99793746. \quad (130)$$

It could be deduced the angle $\omega$ as $\cos^{-1}\omega = 3.68055656$. Now, we could introduce a new correction in the Boltzmann constant translation,

$$K_B = \frac{2\times\varphi\times\cos\omega}{\pi^2\times\alpha^3}\ time^3 space^3 \times \frac{\left(8.09\ldots\times10^{-21}\right)^3 s^3}{(0.0000266\ldots)^3\ time^3} \times \frac{(0.00225\ldots)^3\ space^3}{\left(2.426\ldots\times10^{-12}\right)^3 m^3} \times\frac{1}{(2/\alpha^2)^2} = 1.345879732 * 10^{-23}\ \frac{kg\times m^2}{s^2\times K}. \quad (131)$$

In the same way,

$$\frac{1.345879732\times10^{-23}}{(\cos 6.22547165)^4} = 1.37810076\times10^{-23}\ \frac{kg\times m^2}{s^2\times K}. \qquad (132)$$

This new approach is given by,

$$\frac{1.37810076\times10^{-23}}{1.38064852\times10^{-23}}\times100 = 99.815\,\%. \qquad (133)$$

And equal to the Natural constants approximations before calculated between S.I. and S.U. That $K_B$ would require another correction, has been interpreted as the result of the introduction of an acceleration following this process, when an energy is added to the Spacetime Structure it would bends a certain angle, starting the atom movement, in a dense closed system, the atomic collisions, would produce an energy accumulation that we can measure with the temperature data, as this energy wouldn't be shared with the Spacetime Structure to produce movement but accumulated inside the atoms to become heat.

## 9. Acceleration and spacetime angle bended relationship

In section 7.1., it is calculated the Spacetime angle that would bend a proton, now we will try to establish a relation between this angle and the gravitational acceleration of any celestial body.

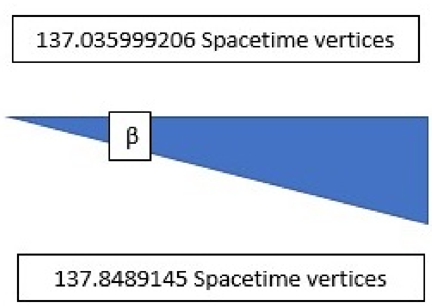


**Figura 4**: Looking at Figure 3 we will consider that the angle $\beta$ and therefore the length of leg $L$, could change proportionally as function of the studied mass or that is equal to its number of protons.

The Newtonian acceleration is described by:

$$g_x = \frac{Gm_x}{r_x^2}. \qquad (134)$$

The length of the leg L can be written as function of $\beta$ angle,

$$L = \frac{\sin\beta}{\cos\beta}r_x = \tan\beta r_x. \qquad (135)$$

As in Structural Units 137.035999206 is defining the Bohr diameter, we can find the expression of proportionality,

$$\frac{\tan\theta r_x}{\tan\beta r_h} = \frac{2g_x}{g_h}, \qquad (136)$$

Where $\theta$ is the angle bended by a celestial body with radius $r_x$, and $g_x$ its Newtonian acceleration or gravity, $\beta$ the proton angle, $r_h$ the Bohr radius and $g_h$ the proton gravity acceleration, we have picked the proton mass and Bohr radius to calculate $g_h$ doing the similarity with a celestial body, considering the proton a four dimensional structure rotating with the Bohr radius. If we develop equation (136) we obtain.

$$N_p = \frac{M_x}{m_p} = \frac{\tan\theta r_x^3}{2\tan\beta r_h^3}. \qquad (137)$$

Being $N_p$ the number of protons of the celestial body studied. To check the hypothesis presented, we will put the numbers of different celestial bodies:

**Earth**: Applying equation (136), considering an Earth radius of 6378000 m and $5.9722\times10^{24}$ kg of mass, isolating the angle $\theta$ it is obtained that the Earth surface would bend 23.98516437 degrees the Spacetime Structure, substituting this value in equation (137) the result is $3.570561883\times10^{51}$ as the Earth's proton number in both sides of the formula.

**Sun**: Considering the Sun radius equal to 696340000 m with a mass about $1.989\times10^{30}$ kg it is calculated an angle of 6.4957116 degrees with $1.1891509\times10^{57}$ protons in both sides of equation (137).

### 9.1. Black Hole spacetime bending angle

Now we are going to try to calculate this Spacetime angle for a black hole. As we know the Schwarzschild radius equation (7) defines a black hole formation, being $M_x$ the mass of any celestial body, $r_s = 2GM_x/c^2$, if we insert this equation in formula (136), isolating the term $\tan\theta$ we obtain,

$$\tan\theta = \frac{\tan\beta r_h^3 c^6}{4G^3M_x^2m_p}. \qquad (138)$$

Making the calculations the result is always near tan 90 due to the elevated numerical value obtained for $\tan\theta$, whose result is infinite, we propose that the Spacetime Structure bending limit is 90 degrees, as equation (138) suggest, being the mathematical expression of a black hole. Also eq. (138) can be simplified to,

$$\tan\theta = \frac{2\tan\beta r_h^3}{r_{sp}r_{sx}^2}. \qquad (139)$$

where $r_{sp}$ and $r_{sx}$ are the Schwarzschild radius of a proton and the celestial body involved, respectively.

## 10. Conclusions

From the experimental data about the density of the Universe Vacuum, measured by the Planck Satellite, we propose a characterization of the Spacetime Structure. Following the calculations done, the Spacetime would behave like a wave that grows as the Universe expands, with a frequency and wavelength equal to the inverse of its age and radius, respectively. The Universe is defined as a huge spherical gravitational wave that weaves Spacetime and sow matter in its path, expanding at the speed of light. The proposed model can calculate the mass of the Universe, defining the Cosmological constant as the first meaning that Einstein gave it, the inverse of Universe radius squared and also can make predictions about its evolution.

The Structure of Spacetime is proposed to be a mesh formed by equidistant energy vertices that holds mass and energy within the Universe, defining gravity as the equivalence between the energies contained in a mass and the Quantum Vacuum that surrounds it, whose deformation produces an acceleration. Once the meaning of the Cosmological constant has been established, its relationship with the Fine Structure constant is settled as the number of vertices of the Spacetime Structure which define a hydrogen atom. We propose that the concepts of Dark Energy/Quantum Vacuum and Structure of Spacetime are synonymous, following the calculations made. Next, the mechanism that could have followed the Big Bang and the Planck constant role is proposed, such as the black hole's evaporation found by Stephen Hawking, until contain the maximum energy in the minimum quantized Spacetime.

Natural constants are also defined as properties inherent to the same Structure of Spacetime, establishing a process that would keep them constant regardless of the age/expansion of the Universe. We use the Hawking-Bekenstein equation on the entropy of a black hole to try to define the concept of information as related to the number of vertices of the Spacetime Structure and its relationship with the Planck constant. Based on the properties of the characterized Structure, we propose a new system of units, the Structural or Spacetime Units, where the Natural constants (CODATA values), since now only determined by experimental data, can be defined by simple mathematical relations between three pure numbers, that are constantly repeated in Nature such as $\pi$, $\phi$ (the Golden ratio) and $\alpha$ (the Fine Structure constant), this could give us a better view of its meaning, discovering a strong connection between them all.

In this new concept, everything contained in the Universe would correspond to different Spacetime configurations of the same Structure that supports it. We have used the Dirac/Eddington large number hypothesis to contrast calculations, since the pure numbers obtained do not depend on the system of units used and finally, we have checked the compatibility between our International System of Units and Structural Units, also introducing the Spacetime angle that would bend a proton.

In the last section, we have tried to put into practice the new equations and concepts presented. The discovery of the relationship between the speed of sound and the minimum quantum kinematic viscosity with some Natural constants and the ideas suggested by its authors about its relationship with black hole physics, has provided an excellent opportunity to try to relate the quantum and macro worlds using Structural Units. Also, we have proposed how the Spacetime bending angle would be related to the gravity acceleration of a celestial body, defining its limit for a black hole formation. The results of this study are also used in the paper published by the same authors, where we try to make a description about photon emission/reception process inside Spacetime geometry under the premises presented in this paper, translating Rydberg equation to Structural Units and proposing an experimental test, where once calculated that each photon would occupy a certain area of Spacetime, it is proposed that the narrowing of a flow of photons (photonic funnels) could produce a bending in Spacetime to allow flux, thus observing an acceleration [17].

## Conflict of interest

The authors declare that there is no conflict of interest.

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## Appendix 1

Although the CODATA values of the different Natural Constants can be found on the following web page, http://physics.nist.gov/constants, we consider useful to include this table with the current S.I. values of some Natural constants and its proposed S.U. equivalences to make calculations easier.

| UNIVERSAL CONSTANT | S.I. VALUE | S.U. VALUE | S.I. UNITS | S.U. UNITS |
|---|---|---|---|---|
| $h$ (Planck constant) | 6.62607015*10$^{-34}$ | $\frac{2}{\alpha^2}$ | $\frac{kg*m^2}{s}$ | $\frac{time^3}{space^2}$ |
| $K_C$ (Coulomb constant) | 8987551793 | $\frac{2}{\alpha^2}$ | $\frac{kg*m^3}{s^2*C^2}$ | $\frac{time^2}{space*Charge^2}$ |
| $G$ (Gravitational constant) | 6.67430*10$^{-11}$ | $2.293135661*10^{-50}*$ | $\frac{m^3}{kg*s^2}$ | $\frac{space^7}{time^6}$ |
| $K_B$ (Boltzmann constant) | 1.380649*10$^{-23}$ | $\frac{2\varphi}{\alpha^3\pi^2}*$ | $\frac{kg*m^2}{s^2*K}$ | $\frac{time^3}{space^3}$ |
| $\mu_0$ (Magnetic permittivity) | 1.256637062*10$^{-6}$ | $8\varphi^2\pi$ | $\frac{kg*m}{C^2}$ | $\frac{time^4}{space^3*Charge^2}$ |
| $\varepsilon_0$ (Electrical permittivity) | 8.85418781*10$^{-12}$ | $\frac{\alpha^2}{8\pi}$ | $\frac{s^2*C^2}{kg*m^3}$ | $\frac{space*Charge^2}{time^2}$ |
| $c$ (speed of light) | 299792458 | $\frac{1}{\varphi\alpha}$ | $\frac{m}{s}$ | $\frac{space}{time}$ |
| $m_e$ (electron rest mass) | 9.10938370*10$^{-31}$ | $\frac{4\varphi^2}{\alpha^2}*$ | $kg$ | $\frac{time^4}{space^4}$ |
| $m_p$ (proton mass) | 1.67262192*10$^{-27}$ | $\frac{1}{(\cos\beta)^4\alpha^4}*$ | $kg$ | $\frac{time^4}{space^4}$ |
| $r_h$ (Bohr radius) | 5.29177210*10$^{-11}$ | $\frac{1}{4\varphi\pi}$ | $m$ | $space$ |
| $e^2$ (electrical charge squared) | 2.56696996*10$^{-38}$ | $\frac{1}{2\varphi\pi}$ | $Coulomb^2$ $C^2$ | $Charge^2$ |
| $f_e$ (electron frequency) | 3.289841957*10$^{15}$ | 1 | $\frac{1}{s}$ | $\frac{1}{time}$ |
| $\lambda_{ce}$ (Compton electron wavelength) | 2.42631023*10$^{-12}$ | $\frac{\alpha}{2\varphi}$ | $m$ | $space$ |
| $t_{ce}$ (Compton electron time) | 8.09329979*10$^{-21}$ | $\frac{\alpha^2}{2}$ | $s$ | $time$ |
| $v_e$ (electron speed) | 2187691.262 | $\frac{1}{\varphi}$ | $\frac{m}{s}$ | $\frac{space}{time}$ |
| $R_h$ (Rydberg constant) | 10973731.568 | $\alpha\varphi$ | $\frac{1}{m}$ | $\frac{1}{space}$ |

**Table 3.** For dimensional analysis in S.I./S.U. translation use this equivalence:

$$kg = \frac{time^4}{space^4}. \tag{140}$$

$$Kelvin = \frac{space}{time}. \tag{141}$$

For calculations with Structural Units:

$$\varphi = 1.618033989. \tag{142}$$

$$\alpha = 7.29735256 \times 10^{-3}. \tag{143}$$

$$\pi = 3.141592654, \tag{144}$$

$$Angle\ \beta = 6.22547165\ degrees \tag{145}$$

(The × indicated values that has been explained in detail in different sections).

## Appendix 2

In section 8.5. are proposed equation (120), (121) and (122), now we are going to introduce the correction done by the angle $\omega$, calculated in Boltzmann constant translation 8.6.

$$m_e = \frac{2\pi^2 k_B}{c \times \cos 3.68055656} = 9.1093837 \times 10^{-31}\ kg. \quad (146)$$

$$m_p = \frac{\pi^4 k_B^2 c^2}{(\cos 3.68055656)^2} = 1.675717524 \times 10^{-27}\ kg. \quad (147)$$

$$\frac{m_p}{m_e} = \frac{\pi^2 k_B c^3}{2 \times \cos 3.68055656} = 1839.550929. \quad (148)$$

If we compare the different results obtained with the experimental CODATA values, a 100 % of correlation is calculated for $m_e$ and a 99.815 % for $m_p$ and $m_p/m_e$, this result would point directly to the conclusion that the electron wouldn‘t bend the Spacetime Structure following the same behavior that a photon, being not needed the correction between the Euclidean and non-Euclidean geometries introduced by the presence of a proton.

## Appendix 3

The Stefan-Boltzmann constant ($\sigma$), present in the Stefan-Boltzmann law that describes the power radiated from a black body as function of its temperature, presents another excellent opportunity to test the arguments made in this paper, this constant follows this equation,

$$\sigma = \frac{2\pi^5 K_B^4}{15h^3c^3} = 5.6703744 \times 10^{-8}\ \frac{W}{m^2 \times K^4} = \frac{kg}{s^3 \times K^4}. \quad (149)$$

We are going to translate to Structural Units equation (149) using table 3, but introducing the angle correction deduced in section 8.6. for the Boltzmann constant,

$$K_B = \frac{2 \times \varphi \times \cos\omega}{\pi^2 \times \alpha^3}. \quad (150)$$

obtaining,

$$\sigma = \frac{4\varphi^6 (\cos\omega)^4}{15\pi^3\alpha^4} = 53975533.08\ \frac{t^5}{s^8}. \quad (151)$$

and to return to S.I.,

$$53975533.08\ \frac{time^5}{space^8} \times \frac{\left(8.09 \times 10^{-21}\right)^5 s^5}{(0.0000266)^5\ time^5} \times \frac{(0.00225)^8\ space^8}{\left(2.426 \times 10^{-12}\right)^8 m^8} \times \frac{1}{(2/\alpha^2)^2} = 5.527565689 \times 10^{-8} \frac{W}{m^2 \times K^4} \quad (152)$$

Applying $\beta$ correction due to proton Spacetime bending,

$$\frac{5.527565689 \times 10^{-8}}{(\cos 6.22547165)^4} = 5.65989835 \times 10^{-8}\ \frac{W}{m^2 \times K^4}. \quad (153)$$

Then,

$$\frac{5.65989835 \times 10^{-8}}{5.670374419 \times 10^{-8}} \times 100\,\% = 99.815\,\%. \quad (154)$$

Coincident with the same approach found for the other Natural constants translation and attributed to Euclidean extrapolation to the non-Euclidean Spacetime geometry.

## Appendix 4

In order to continue checking the full compatibility between our International Unit‘s System and S.U., we are going to calculate the gravity acceleration in Earth surface ($g$) in both unit‘s systems and then perform the dimensional analysis to compare the results.
S.I. calculation:
$M_E$= Earth mass: $5.97219 \times 10^{24}$ kg
$R_E$= Earth radius: 6378000 m
G= Gravitational constant: $6.6743 \times 10^{-11}$ m$^3$/(kg×s$^2$)

$$g = \frac{GM_E}{R_E^2} = 9.798741706\ \frac{m}{s^2}. \quad (155)$$

S.U. calculation:
$\alpha$=1/137.035999206
$\beta$= 6.22547165 °
$\pi$= 3.141592654
$\phi$= 1.618033989

First, we would need to translate the terms of the Newton equation from our International Units System to Structural Units:

**Earth mass**: To proceed we will calculate the total number of Earth protons ($N_p$) by dividing the Earth mass by the one of a proton:

$$Np = \frac{5.97219 \times 1024\ kg}{1.67262192 \times 10^{-27} kg} = 3.5705558 \times 10^{51} \quad (156)$$

Then the number of Earth's protons is multiplied by the proton mass in Structural Units, that is described with the inverse of the Fine Structure constant and the angle correction due to Spacetime proton bending ($\beta$= 6.22547165 degrees) elevated to the fourth, as the mass in S.U. is the 4D Spacetime representation:

$$m_p = \frac{1}{(\cos\beta)^4\,\alpha^4}\,\frac{time^4}{space^4} \tag{157}$$

$$M_E = 3.5705558\times 10^{51}\ protons\ \times$$
$$\frac{1}{(\cos\beta)^4\,\alpha^4}\frac{time^4}{space^4} = 1.289285903\times 10^{60}\ \frac{time^4}{space^4} \tag{158}$$

**Earth radius**: To calculate the Earth radius we will proceed to divide the Earth radius in meters by the Compton electron wavelength, as we propose that the Spacetime is quantized in this precise length.

$$r_E = \frac{6378000\ m}{2.42631023\times 10^{-12}\ m} =$$
$$2.6286828\times 10^{18}\ Spacetime\ vertices. \tag{159}$$

Then we will multiply the number of Spacetime vertices by the separation in Space in Structural Units and equivalent to the Compton electron wavelength in S.U. ($\alpha/2\varphi$ space).

$$r_E = 2.6286828\times 10^{18}\ Spacetime\ vertices\ \times$$
$$\frac{\alpha}{2\varphi}\ space = 5.92769539\times 10^{15}\ space. \tag{160}$$

And the last one is the Gravitational constant, whose value in S.U. can be obtained following the section 7.3.

Once we have translated all the terms of the Newtonian equation to S.U. we can do the calculations to obtain the Earth gravity acceleration in Structural Units:

$$g = \frac{GM_E}{R_E^2} = \frac{2.2931356\times 10^{-50}\ \frac{space^7}{time^6}\times 1.289285903\times 10^{60}\ \frac{time^4}{space^4}}{(5.92769539\times 10^{15}\ space)^2} = 8.414091188\times 10^{-22}\ \frac{space}{time^2}. \tag{161}$$

Then we are going to do the dimensional analysis to return the value of $g$ to the International Units system using the table values of the Compton electron wavelength ($\lambda_c e$) and time ($t_c e$).

$$8.414091188\times 10^{-22}\ \frac{space}{time^2}\times\frac{\lambda_{ce}\ S.I.}{\lambda_{ce}\ S.U.}\times\frac{t_{ce}^2\ \ S.U.}{t_{ce}^2\ S.I.} = 9.798417826\ \frac{m}{s^2}. \tag{162}$$

If we compare both results obtained we found:

$$\frac{9.798417826\ \frac{m}{s^2}}{9.798741706\ \frac{m}{s^2}}\times 100\,\% = 99.9966946\,\%. \tag{163}$$

Showing again the complete compatibility between S.I. and S.U.