SYMMETRIC THEORY
Planck's Particle

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Abstract
The properties of symmetry of the Planck particle will be presented, and its magnetic charge will be extracted. This particle unifies the gravitational force, the electric force and the magnetic force into a single one, referred to as *superforce.* The physical meaning of permeability of vacuum constants, of $\hbar c$, and of zero-point energy will be shown.

Keywords: Planck's particle, magnetic monopole, coupling constants, superforce, Planck's constant, vacuum permeability, zero-point energy.

1 - Introduction
Scientific discoveries in physics have shown that the description of natural phenomena does not depend on the particular choice of the reference system (Principle of general covariance), and thanks to this peculiarity, the physics that applies here and now, will also apply anywhere at any time. Moreover, it is assumed that some phenomena are always the same, irrespective of time and place. These entities are the *constants of nature*, which, in some sense, contain in themselves the secret of the universe, and shape the reality in which we live.
The search for this constants began with Lord Rayleigh and J. C. Maxwell in 1870, and continued with G.J. Stoney, who had the merit of creating a connection between the constants and the fundamental aspects of the universe, and reached its completeness with M. Planck, who introduced the *natural units*, which maintain their meaning at all times and in all environments.[1]
At the state of the art, the universe is described via the Standard Model, which does not, crucially, include gravitation, thereby leaving unresolved the question of unification of gravitation and electromagnetism. The main difficulty in attaining this lies in the fact that, whereas gravitation is described by General Relativity in a classical, deterministic structure, electromagnetism is described in a probabilistic structure by Quantum Mechanics.

2 - Symmetric Particle
Coulomb's Force and Newton's Force play a decisive role in the universe. These are fundamental forces that have the same dependency from the distance, $1/r^2$, and allow periodic motion on closed orbits (Bertrand's Theorem).
The electrostatic force between two charged particles is expressed via Coulomb's Law in the form (M.K.S. system will be used) [2]

$$F_e = \frac{1}{4\pi\varepsilon_o}\frac{q_1 q_2}{r^2} \tag{1}$$

with q_1 and q_2 the charge of the two particles, r their spatial separation, and where

$$\varepsilon_o = 8{,}854 \times 10^{-12} \left[\frac{\sec^2\ C^2}{m^3\ Kg}\right] \tag{2}$$

is dielectric constant of vacuum.
Newton's gravitational force, between two bodies of mass m_1 and m_2 respectively, separated again at a distance r, is expressed by the law [3]

$$F_g = G\frac{m_1 m_2}{r^2} \tag{3}$$

with G, the gravitational constant, equal to

$$G = 6{,}674 \times 10^{-11} \left[\frac{m^3}{Kg\ \sec^2}\right] \tag{4}$$

The gravitational force is attractive, that is why a minus sign appears in (3), while Coulomb's force can be either attractive or repulsive, depending on whether the two charges are opposite or equal.
Suppose expressing the gravitation constant G in the form

$$G \equiv \frac{1}{4\pi G_o} \qquad (5)$$

from which it is obtained

$$G_o \equiv \frac{1}{4\pi G} = 1{,}193 \times 10^9 \left[\frac{Kg \ \sec^2}{m^3}\right] \qquad (6)$$

This assumption, in addition to providing an identical formalism between Coulomb's and Newtons's forces, allows the introduction of the constant G_o for gravitation, as an analogous constant to ε_o for electromagnetism. G_o will be referred to as the *gravitational permeability of vacuum.*
Consider now the ratio (indicated by $Æ$ for convenience)

$$Æ^2 \equiv \frac{\varepsilon_o}{G_o} = \frac{8{,}854 \times 10^{-12}}{1{,}193 \times 10^9} = 7{,}425 \times 10^{-21} \left[\frac{C^2}{Kg^2}\right] \qquad (7)$$

from which it is obtained

$$Æ \equiv \pm\sqrt{\frac{\varepsilon_o}{G_o}} = \pm\ 8{,}617 \times 10^{-11} \left[\frac{C}{Kg}\right] \qquad (8)$$

Via the dimensional calculation it can be noticed that $Æ$ expresses the ratio between charge and mass:

$$Æ \equiv \frac{q}{m} \qquad (9)$$

In this analysis, I will refer to *symmetric particle* as that particle whose ratio between its charge and its mass is equal to $Æ$, this will be referred to as the *factor of symmetric coupling* of the symmetry relation in (9).

3 - Magnetic monopole of the symmetric particle

Already from Maxwell's equation, the existence of magnetic monopoles is formally hypothesised, but the interest for this objects increased after P.A.M. Dirac's 1931 article, where it was shown that magnetic charges can indeed be introduced in the structure of Quantum Mechanics. In that precise context, it is maintained that the lacking symmetry of electrodynamics demands that the product between the unit electric charge and the unit magnetic charge be quantised [4]. This particle is called *magnetic monopole* if it carries only one magnetic charge, and *dion* if it carries both the electric and the magnetic charges (a monopole attached to a nucleus behaves like a dion). [5] [6]
Another important date in the history of magnetic monopoles is 1974. In that year, 't Hooft and Polyakov showed that the Grand Unified Theory (GUT) between electroweak and electrostrong interactions implied the existence of magnetic monopoles with masses of the order of 10^{17} GeV/c^2. These masses are too big to be produced in modern accelerators. Various hypotheses map them onto products of the Big Bang, or to collision of high energy immediately after the transition of phase which took place at the end of the GUT era. In fact, as of today, magnetic monopoles have never been observed. [7] [8]

Against this backdrop, consider Maxwell's relation

$$c^2 = \frac{1}{\mu_o \varepsilon_o} \qquad (10)$$

which ensures that the value of the speed of light in the vacuum is expressible via two universal constants, where

$$\mu_o = 4\pi \times 10^{-7} \left[\frac{m\,Kg}{C^2}\right] \qquad (11)$$

is the magnetic permeability of vacuum.
From Maxwell's relation in (10), it is possible to obtain

$$\varepsilon_o = \frac{1}{\mu_o c^2} \quad (12)$$

Considering the factor of symmetric coupling such as in (7), it is possible to rewrite

$$Æ^2 = \frac{\varepsilon_o}{G_o} = \frac{1}{G_o \mu_o c^2} \quad (13)$$

from which it obtains, taking into account the first and the last term,

$$Æ^2 G_o \mu_o c^2 = 1 \quad (14)$$

This expression allows the introduction of G_o in Maxwell's relation.

The sources of electric field are the electric charges in motion. In the hypothesis of dealing with *symmetric particles*, let us analyse dimensionally the product between charge q, the speed of light in the vacuum c, and the magnetic permeability μ_o:

$$q\,c\,\mu_o = [C] \times \left[\frac{m}{\sec}\right] \times \left[\frac{m \times Kg}{C^2}\right] = \left[\frac{m^2 \times Kg}{\sec \times C}\right] \quad (15)$$

It is known that magnetic monopoles, dimensionally, are expressed in Weber [9]

$$[Weber] = \left[\frac{m^2 \times Kg}{\sec \times C}\right] \quad (16)$$

Therefore, it is possible to define another property of symmetric particles, i.e. they have a magnetic charge equal to

$$g \equiv q\,c\,\mu_o \quad (17)$$

By exploiting the relation (9), from which $q \equiv Æ\,m$ can be obtained, it is possible to write

$$g \equiv m\,Æ\,c\,\mu_o \quad (18)$$

By considering Maxwell's relation (10), it is also possible to write (17) as

$$g \equiv \frac{q}{c\,\varepsilon_o} \equiv \frac{m\,Æ}{c\,\varepsilon_o} \quad (19)$$

Equation (17) point to the fact that the magnetism of a symmetric particle is a relativist effect, which in itself is rather known, while equation (18) shows that the magnetic monopole of the symmetric particle is linkable to the mass of the symmetric particle. Therefore, in the same way as an electric charge in motion produces magnetic phenomena, by the same token, a mass in motion would produce magnetic phenomena. As a matter of fact there already exists a theory, GEM Theory (Gravitomagnetism), developed by Heaviside [10], which makes reference to a collection of formal analogies between Maxwell's and Einstein's field equations, approximately valid in certain conditions. The most common version of GEM is valid for weak fields and for particles in slow motion. This approximated formulation of gravitation, described by General Relativity, induces the appearance of a *fictitious force* for gravitating bodies. By analogy with electromagnetism, this fictitious force is also called *gravitomagnetic force,* insofar as it is created in the same way in which an electric charge in motion creates a magnetic field. A consequence of the gravitomagnetic force is that an object in free fall, near to a rotating heavy body, it itself rotates [11]. A blatant example of this can be found, not in the abysses of universe, but rather in our solar system. All the planets in the solar gravitation field rotate showing a spin, and the sun itself has a rotatory motion.

4 - The search for a symmetric particle - Planck's Particle

The hypothesis so far put forward imposes precise limitations on the search for a *symmetric particle.* Not only must the ratio between its charge and its mass be constant, but it has to also have a precisely defined value, which is dictated by the symmetric coupling factor $Æ$, as defined in equation (9).

We first focus our attention on the electron, in order to verify whether it possess this property. Drawing on the scientific literature, it is known that the electron has the following charge and mass: [12]

e = 1,602 x 10^{-19} C $\qquad$ m_e = 9,109 x 10^{-31} Kg with a specific ratio

$$\frac{e}{m_e} = 1{,}758 \times 10^{11} \left[\frac{C}{Kg}\right] \neq Æ \qquad Æ = 8{,}617 \times 10^{-11}\left[\frac{C}{Kg}\right] \tag{20}$$

As it is possible to see, *the electron cannot be a symmetric particle.*
Nor can the proton be a symmetric particle, in light of the fact that it has a mass almost 2000 times bigger than the electron's mass.
It is to be added that the electron would verify the relation of symmetric coupling, if it had a mass equal to Stoney's mass, defined as [13]

$$m_S \equiv \sqrt{\frac{e^2}{4\pi G \varepsilon_o}} \tag{21}$$

Seeing as $4\pi G \equiv 1/G_o$, substitution would obtain

$$m_S = \sqrt{\frac{e^2\, G_o}{\varepsilon_o}} = e\sqrt{\frac{G_o}{\varepsilon_o}} = \frac{e}{Æ} \;\Rightarrow\; Æ = \frac{e}{m_S} \tag{22}$$

Consider, now, *Planck units*, exclusively defined in terms of universal constants physics, as proposed by Planck in 1899. Our interest in this context lies solely on their definitions. In particular, consider Planck mass and Planck charge, so defined [14]

$$m_P \equiv \sqrt{\frac{\hbar c}{G}} = 2{,}176 \times 10^{-8}\ [Kg] \tag{23}$$

$$q_P \equiv m_P\sqrt{4\pi G \varepsilon_o} = \sqrt{4\pi \varepsilon_o \hbar c} = 1{,}875 \times 10^{-18}\ [C] \tag{24}$$

Substituting $4\pi G \equiv 1/G_o$ in the first equivalence of Planck charge, we obtain

$$q_P = m_P\sqrt{\frac{\varepsilon_o}{G_o}} = m_P\sqrt{Æ^2} = \pm m_P\, Æ \tag{25}$$

For the sake of this discussion, the double sign in (25) is not necessary at this very moment (its implications will be analysed later on), even though its meaning is clear: the electric charge of the Planck particle can either be positive or negative, as so happens in nature. It is, instead, interesting to observe that in (25) the double sign is ascribable to the two terms of the equations, namely either Planck mass m_p or to $Æ$, with important conceptual differences in the physical reality that follows.
If the double sign were attributed to the mass, this would mean that we should posit the existence of antimatter; whereas, if it were attributed to $Æ$, the double sign would give a double polarity to the vacuum field.
For the time being, suppose that (25) is assumed in absolute value

$$q_P \equiv m_P\, Æ \tag{26}$$

from which obtains

$$Æ = \frac{q_P}{m_P} \tag{27}$$

It is thus evident that the *Planck particle, as defined in the characteristic dimensions introduced by Planck, is a symmetric particle.*
In what follows, other relationships connecting the characteristics of the Planck particle will be searched for and analysed.

5 - Coupling constants
The electromagnetic coupling constant (the fine structure constant α) has been calculated in relation to the electron in its first stationary orbit of an atom of hydrogen [12]

$$\alpha = \frac{e^2}{4\pi\varepsilon_o \hbar c} = \frac{e^2}{q_P^2} \tag{28}$$

It seems therefore theoretically sound to wonder whether there exist a coupling between the mass of the electron and Planck mass.

The scientific literature proposes different gravitational coupling constants depending on the chosen particle. In light of the fact that the relationship between the mass of the electron and Planck mass is now being considered, the best estimate is the one between a pair of electrons, given by the relation [15]

$$\alpha_G = \frac{G m_e^2}{\hbar c} \qquad (29)$$

Squaring equation (23) we obtain

$$\hbar c = G m_P^2 \qquad (30)$$

thus substituting in (29) we obtain

$$\alpha_G = \frac{G m_e^2}{\hbar c} = \frac{G m_e^2}{G m_p^2} \equiv \frac{m_e^2}{m_p^2} \qquad (31)$$

This coupling is estimated by the relation

$$\alpha_G \equiv \frac{m_e^2}{m_p^2} = \frac{G m_e^2}{\hbar c} = \frac{m_e^2}{4\pi G_o \hbar c} \qquad (32)$$

Utilising (32) and (27), it is possible to obtain

$$\alpha_G \equiv \frac{m_e^2}{m_P^2} \equiv \frac{m_e^2}{q_P^2} Æ^2 \qquad (33)$$

with value

$$\alpha_G \equiv 1{,}762 \text{ x } 10^{-45} \qquad (34)$$

It now becomes relevant whether the factor of symmetric coupling $Æ$ can represent a coupling constant between the electrostatic field and the gravitostatic field.

During the primordial phase, when the Universe is imagined as a state at an extremely high temperature (close to Planck temperature, ca. 10^{31} °K, ca. 10^{-43} sec from its birth) according to the *standard cosmological model*, every bound state is impossible. Every atom or every nucleus produced is immediately destroyed by the high-energy photons. According to the standard model of elementary particles, at the high primordial temperatures, the three interactions were unified in one single form of interaction. The number and the temperature of the particles of the primordial plasma were maintained in thermodynamic equilibrium by this form of unified interaction. [16]

The electrostatic force between two identical particles, characterised by charge q_P and mass m_P, at a distance r, will be

$$F_e = \frac{1}{4\pi\varepsilon_o} \frac{q_P \cdot q_P}{r^2} \qquad (35)$$

By virtue of the relation $q_P = Æ\, m_P$, it follows that

$$F_e = \frac{1}{4\pi\varepsilon_o} \frac{(Æ\, m_P)\cdot(Æ\, m_P)}{r^2} = \frac{Æ^2}{4\pi\varepsilon_o} \frac{m_P \cdot m_P}{r^2} \qquad (36)$$

Considering that $\frac{Æ^2}{\varepsilon_o} = \frac{1}{G_o}$, we obtain

$$F_e = \frac{1}{4\pi G_o} \frac{m_P \cdot m_P}{r^2} \qquad (37)$$

which is the Newtonian gravitational force between two particles having Planck mass m_P.

The result insures that Planck's particles will be subject, at the same time, to the same force from the *gravitostatic* and *electrostatic* point of view, i.e. they will be in a condition of *gravito-electrostatic unification*

$$\frac{1}{4\pi G_o} \frac{m_P^2}{r^2} = \frac{1}{4\pi\varepsilon_o} \frac{q_P^2}{r^2} \qquad (38)$$

Let us now extend this result to magnetic charges.
From magnetism theory, it is known that a magnetic charge, or magnetic pole, should have an individuality on a par with the electric charge. However, it is also known that this is pure formality, as it is impossible to separate a magnetic pole from its opposite. Yet, the magnetic charge is also envisaged as a parameter for the quantisation of the electric charge, and so far nothing prevents it existence. This formal analogy will therefore be put into use.

We will then talk about the magnetic force exerted between two magnetic poles g_1 and g_2, separated at the distance r , as expressed in the form [9]

$$F_m = \frac{1}{4\pi\mu_o}\frac{g_1 \cdot g_2}{r^2} \tag{39}$$

Consider, now, the electrostatic force between two Planck particles

$$F_e = \frac{1}{4\pi\varepsilon_o}\frac{q_P \cdot q_P}{r^2} \tag{40}$$

Seeing as the Planck particle has a velocity equal to the speed of light in the vacuum c , we define the magnetic charge of Planck's particle through equation (17)

$$g_P \equiv q_P\, c\, \mu_o \equiv \frac{q_P}{c\,\varepsilon_o} \tag{41}$$

obtaining $q_P \equiv \frac{g_P}{c\,\mu_o} \equiv g_P\, c\, \varepsilon_o$, which enters equations (40), resulting in

$$F_e = \frac{1}{4\pi\varepsilon_o}\frac{\left(\frac{g_P}{c\,\mu_o}\right)\cdot\left(\frac{g_P}{c\,\mu_o}\right)}{r^2} \tag{42}$$

hence

$$F_e = \frac{1}{\mu_o^2 c^2}\frac{1}{4\pi\varepsilon_o}\frac{g_P \cdot g_P}{r^2} \tag{43}$$

From Maxwell's relation $c^2 = 1/(\mu_o\,\varepsilon_o)$, we obtain $\mu_o\, c^2 = 1/\varepsilon_o$, and substituting in (43)

$$F_e = \frac{\varepsilon_o}{\mu_o}\frac{1}{4\pi\varepsilon_o}\frac{g_P \cdot g_P}{r^2} = \frac{1}{4\pi\mu_o}\frac{g_P \cdot g_P}{r^2} = F_m \tag{44}$$

which is fully analogous to the magnetic force (39) between two Planck monopoles.
We therefore extend the condition of gravito-electric unification into a static *gravito-electro-magnetic unification*

$$\frac{1}{4\pi G_o}\frac{m_P^2}{r^2} = \frac{1}{4\pi\varepsilon_o}\frac{q_P^2}{r^2} = \frac{1}{4\pi\mu_o}\frac{g_P^2}{r^2} \tag{45}$$

From (41) we obtain

$$g_P \equiv q_P\, c\, \mu_o \equiv \frac{q_P}{c\,\varepsilon_o} = 7{,}044\text{x}10^{-16}\ \text{[Weber]} \tag{46}$$

also rewritable, exploiting the relation in (26), as

$$g_P \equiv m_P\, Æ\, c\, \mu_o \tag{47}$$

Considering now (41), we rewrite it in a different way, exploiting (23) and (24)

$$g_P = q_P\, c\, \mu_o = c\, \mu_o\, m_P \sqrt{4\pi\varepsilon_o G} = c\, \mu_o \sqrt{\frac{\hbar c}{G}} \cdot \sqrt{4\pi\varepsilon_o G} =$$

$$= \sqrt{c^2\, \mu_o^2 \cdot \frac{\hbar c}{G} \cdot 4\pi\varepsilon_o G} = \sqrt{c^2\, \mu_o^2\, \hbar c\, 4\pi\varepsilon_o} \tag{48}$$

Using Maxwell's relation (10), it obtains

$$g_P = \sqrt{\frac{1}{\mu_o \varepsilon_o} \mu_o^2 \hbar c 4\pi \varepsilon_o} = \sqrt{4\pi \mu_o \hbar c} \tag{49}$$

Thus

$$g_P \equiv \sqrt{4\pi \mu_o \hbar c} \tag{50}$$

It is now almost automatic to introduce a constant of magnetic coupling, in analogy with the two coupling constants already introduced, as made explicit in (28) and (32), i.e.

$$\alpha = \frac{e^2}{q_P^2} = \frac{e^2}{4\pi \varepsilon_o \hbar c} \quad (28) \qquad\qquad \alpha_G = \frac{m_e^2}{m_P^2} = \frac{m_e^2}{4\pi G_o \hbar c} \quad (32)$$

The analogy allows the definition of the magnetic coupling constant between electron and Planck's particle as

$$\alpha_M \equiv \frac{g_e^2}{g_P^2} = \frac{g_e^2}{4\pi \mu_o \hbar c} \tag{51}$$

where g_e represents the magnetic monopole of the electron.

Moreover, because $Æ = \frac{q_P}{m_P}$, it seems legitimate to wonder to what the ratios $\frac{m_P}{g_P}$ and $\frac{q_P}{g_P}$ are equal. We already know the following relations:

$$m_P = \sqrt{\frac{\hbar c}{G}} \equiv \sqrt{4\pi G_o \hbar c} \tag{52}$$

$$q_P \equiv Æ\, m_P \equiv \sqrt{4\pi \varepsilon_o \hbar c} \tag{53}$$

$$g_P \equiv \mu_o c q_P \equiv \sqrt{4\pi \mu_o \hbar c} \tag{54}$$

Calculating everything in quadratic terms, we obtain

$$\frac{q_P^2}{m_P^2} = Æ^2 = \frac{\varepsilon_o}{G_o} \qquad \text{(already obtained)} \tag{55}$$

$$\frac{q_P^2}{g_P^2} \equiv \frac{4\pi \varepsilon_o \hbar c}{4\pi \mu_o \hbar c} \equiv \frac{\varepsilon_o}{\mu_o} \tag{56}$$

$$\frac{m_P^2}{g_P^2} \equiv \frac{4\pi G_o \hbar c}{4\pi \mu_o \hbar c} \equiv \frac{G_o}{\mu_o} \tag{57}$$

The ratios all represent coupling factors between the quantities that characterise Planck's particle.

Finally, we turn our attention to the rule of quantisation, considering the product $q_P \cdot g_P$. Using equations (53) and (54), we obtain

$$q_P\, g_P = \sqrt{4\pi \varepsilon_o \hbar c} \cdot \sqrt{4\pi \mu_o \hbar c} = \sqrt{\left(4\pi \hbar c\right)^2 \mu_o \varepsilon_o} \tag{58}$$

and exploiting Maxwell's relation (10), we arrive at

$$q_P\, g_P = \sqrt{\left(4\pi \hbar c\right)^2 \frac{1}{c^2}} = \sqrt{\left(4\pi \hbar\right)^2} = 4\pi \hbar = 2h \tag{59}$$

6 - Planck's Force - the Superforce

Consider the gravitation force between two Planck's particles put at a distance equal to Planck's length ℓ_P:

$$F_G \equiv \frac{1}{4\pi G_o} \frac{m_P^2}{\ell_P^2} = G \frac{m_P^2}{\ell_P^2} \tag{60}$$

where

$$m_P = \sqrt{\frac{\hbar c}{G}} \qquad \ell_P = \sqrt{\frac{\hbar G}{c^3}} = \frac{m_P G}{c^2} \tag{61}$$

Substituting in (60) it follows that

$$F_G = G\frac{m_P^2}{\ell_P^2} = G\frac{\hbar c}{G}\cdot\frac{c^3}{\hbar G} = \frac{c^4}{G} \tag{62}$$

In the same fashion, the electrostatic force between two Planck's particles, put a Planck's distance ℓ_P, will be

$$F_E = \frac{1}{4\pi\varepsilon_o}\frac{q_P^2}{\ell_P^2} = \frac{1}{4\pi\varepsilon_o}\frac{4\pi\varepsilon_o\hbar c}{\hbar G}\cdot c^3 = \frac{c^4}{G} \tag{63}$$

And again, the magnetic force between two Planck's particles, put at a Planck's distance ℓ_P, will be

$$F_M = \frac{1}{4\pi\mu_o}\frac{g_P^2}{\ell_P^2} = \frac{1}{4\pi\mu_o}\frac{4\pi\mu_o\hbar c}{\hbar G}\cdot c^3 = \frac{c^4}{G} \tag{64}$$

As said above, all of Planck's forces are in a *condition of static gravito-electro-agnetic unification*, and are equal to c^4/G

$$F_P = \frac{1}{4\pi G_o}\frac{m_P^2}{\ell_P^2} = \frac{1}{4\pi\varepsilon_o}\frac{q_P^2}{\ell_P^2} = \frac{1}{4\pi\mu_o}\frac{g_P^2}{\ell_P^2} \equiv \frac{c^4}{G} \tag{65}$$

Bearing in mind that these forces are calculated at a minimum distance possible, that is Planck's length, with maximum electric charge, or maximum mass, or still maximum magnetic monopole, this force is referred to as *maximum force* or *superforce* [17][18][19] [20]

$$F_P = F_{\max} \equiv \frac{c^4}{G} \tag{66}$$

It is interesting to notice that the superforce appears in the formulation of general relativity, in Einstein's equations field [21]

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \kappa T_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu} \tag{67}$$

where $G_{\mu\nu}$ is Einstein's curvature tensor, and $T_{\mu\nu}$ is energy-impulse density tensor.

It is also to be noted that the superforce is egual to the product between Planck energy density and the squared Planck lenght

$$\frac{c^4}{G} = \rho_P c^2 \ell_P^2 \tag{68}$$

where Planck energy density is defined as

$$\rho_P = \frac{m_P}{\ell_P^3} = \frac{c^5}{\hbar G^2} \tag{69}$$

Hence, (68) can be espressed as

$$\frac{c^4}{G} = \frac{\rho_P c^2}{\frac{1}{\ell_P^2}} \tag{70}$$

that is, the ratio between energy density and Gauss curvature radius.

Another expression of super force is obtained via the second equivalence of Planck length in (61)

$$\frac{m_P c^2}{\ell_P} = \frac{m_P c^2}{\frac{m_P G}{c^2}} = m_P c^2 \frac{c^2}{m_P G} = \frac{c^4}{G} \tag{71}$$

which expresses the concept of energy as work of a force

$$m_P c^2 = \frac{c^4}{G} \ell_P \qquad (72)$$

7 – Planck's constant $\hbar$

In relation to Planck's unities definitions, we obtein :

$$m_P = \sqrt{4\pi G_o \hbar c} \quad \Rightarrow \quad m_P^2 = 4\pi G_o \hbar c \quad \Rightarrow \hbar c = \frac{m_P^2}{4\pi G_o} \qquad (73)$$

$$q_P = \sqrt{4\pi \varepsilon_o \hbar c} \quad \Rightarrow \quad q_P^2 = 4\pi \varepsilon_o \hbar c \quad \Rightarrow \hbar c = \frac{q_P^2}{4\pi \varepsilon_o} \qquad (74)$$

$$g_P = \sqrt{4\pi \mu_o \hbar c} \quad \Rightarrow \quad g_P^2 = 4\pi \mu_o \hbar c \quad \Rightarrow \hbar c = \frac{g_P^2}{4\pi \mu_o} \qquad (75)$$

From these we extract

$$\hbar c \equiv \frac{m_P^2}{4\pi G_o} \equiv \frac{q_P^2}{4\pi \varepsilon_o} \equiv \frac{g_P^2}{4\pi \mu_o} \qquad (76)$$

The relation (76) allows us to identify Planck's constant as an unvariable constant of nature. But it points out especially it isn't restriced by the definition of action quantum. It can be considered as a parameter of scale which makes possible the passage among the three typical forces.

From the demensional point of view, the product $\hbar c$ has the dimensions of a force for a surface :

$$[\hbar]\cdot[c] = \left[\frac{Kg \times m^2}{\sec}\right]\cdot\left[\frac{m}{\sec}\right] = \left[\frac{Kg \times m}{\sec^2}\right]\cdot\left[m^2\right]$$

This result can be obtained if we multiply and divide for ℓ_P^2 one of (75) equalities. For example, choosing the first :

$$\hbar c = \frac{m_P^2}{4\pi G_o \ell_P^2} \ell_P^2 = F_{\max} \cdot \ell_P^2 \qquad (77)$$

The same result can be obtained if it is applied to the other (76) equalities.

Furthermore we can obtain the same result if we consider the maximum force (66) and $\hbar c$ definition of (76), we obtain

$$\frac{\hbar c}{\ell_P^2} \equiv \frac{c^4}{G} \qquad (78)$$

8 - Vacuum

If we consider the (63), that rewrite

$$F_E = \frac{1}{4\pi \varepsilon_o} \frac{q_P^2}{\ell_P^2} = \frac{c^4}{G} \qquad (63)$$

we obtain

$$\varepsilon_o = \frac{\left(\frac{1}{4\pi} \frac{q_P^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)} \qquad (79)$$

Applying this result to the expression of Coulomb's force between two charges, we have

$$F_E=\frac{1}{4\pi\varepsilon_o}\frac{q_1q_2}{r^2}=\frac{1}{4\pi\left[\frac{\left(\frac{1}{4\pi}\frac{q_P^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)}\right]}\frac{q_1q_2}{r^2}=\frac{\left(\frac{c^4}{G}\right)}{4\pi\left(\frac{1}{4\pi}\frac{q_P^2}{\ell_P^2}\right)}\frac{q_1q_2}{r^2}=$$

$$=\frac{\left(\frac{c^4}{G}\right)}{\left(\frac{q_P^2}{\ell_P^2}\right)}\frac{q_1q_2}{r^2}=\left(\frac{c^4}{G}\right)\frac{\left(\frac{q_1}{q_P}\right)\left(\frac{q_2}{q_P}\right)}{\left(\frac{r}{\ell_P}\right)^2} \tag{80}$$

In the particular case of a couple of electrons, $q_1=q_2=e$, placed in Planck's distance, $r=\ell_P$, this force has the following form

$$F_E=\frac{1}{4\pi\varepsilon_o}\frac{e^2}{\ell_P^2}=\left(\frac{c^4}{G}\right)\frac{\left(\frac{e^2}{q_P^2}\right)}{\left(\frac{\ell_P}{\ell_P}\right)^2}=\left(\frac{c^4}{G}\right)\alpha \tag{81}$$

where the relation (28) is assumed for the fine structure constant. Finally we have

$$\alpha=\frac{\left(\frac{1}{4\pi\varepsilon_o}\frac{e^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)} \tag{82}$$

that gives us one of the possible meanings of α: it represents the electric force between a couple of electrons placed in the minimum distance in the vacuum, as to the maximum force.

We can do the same thinking for μ_o considering the (64)

$$F_M=\frac{1}{4\pi\mu_o}\frac{g_P^2}{\ell_P^2}=\frac{c^4}{G} \tag{64}$$

from which we come to

$$\mu_o=\frac{1}{4\pi}\frac{g_P^2}{\ell_P^2}\frac{G}{c^4}=\frac{\left(\frac{1}{4\pi}\frac{g_P^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)} \tag{83}$$

and for G_o, considering the (62)

$$G_o=\frac{\left(\frac{1}{4\pi}\frac{m_P^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)} \tag{84}$$

With the same thinking made before, we obtain

$$\alpha_G = \frac{\left(\frac{1}{4\pi G_o}\frac{m_e^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)} \tag{85}$$

and the same is for the magnetic part

$$\alpha_M = \frac{\left(\frac{1}{4\pi \mu_o}\frac{g_e^2}{\ell_P^2}\right)}{\left(\frac{c^4}{G}\right)} \tag{86}$$

8 – Planck medium

We had left an outstanding matter when we have discussed the formula (25) that we rewrite

$$q_P = \pm m_P Æ \qquad (25)$$

We had said that double sign identifies Planck's charge double polarity, that can be both positive and negative, both a negative electron and a positive proton. In my opinion Planck's double charge, both positive and negative, *coexists* making a *permanent electric dipole* that represents the basic condition of Planck's environment that we call *Planck medium*.

Assuming this hypothesis, banally Planck's dipole could be argued as a condenser made up of two charged bodies, charged $+q_P$ and $-q_P$, and we can calculate the capacitance, or the ability to store energy.

The condenser capacitance is defined as [9]

$$C = \frac{Q}{\Delta V} \tag{87}$$

where Q is the charge in the absolute value distributed on the single plate and ΔV is the potential difference between the plates.

As that we don't have a definition of Planck's potential difference, we hypothesize that to move one of Planck's charge along a route with a potential difference ΔV_p, we have to do a work, or supplying it with energy, equal to

$$E_P = q_P \, \Delta V_P \tag{88}$$

therefore

$$\Delta V_P = \frac{E_P}{q_P} \tag{89}$$

Assuming for Planck's energy the relation

$$E_P = m_P c^2 \tag{90}$$

Planck's capacitance becomes

$$C_P = \frac{q_P}{\Delta V_P} = \frac{q_P}{\left(\frac{E_P}{q_P}\right)} = \frac{q_P^2}{E_P} = \frac{m_P^2\left(4\pi\varepsilon_o G\right)}{m_P c^2} = \frac{m_P\left(4\pi\varepsilon_o G\right)}{c^2} \tag{91}$$

where we have adopted the (24) to couch Planck's charge.

The stored energy by a condenser, that we can immagine distributed all over the electic field in the surrounding space, is defined by the relation [9]

$$u_C = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2} C \, \Delta V^2 \tag{92}$$

and for Planck's condenser the energy will be

$$u_{PC}=\frac{1}{2}\frac{q_P^2}{C_P}=\frac{1}{2}\frac{m_P^2\left(4\pi\varepsilon_o G\right)}{\left[\frac{m_P\left(4\pi\varepsilon_o G\right)}{c^2}\right]}=$$

$$=\frac{1}{2}m_P^2\left(4\pi\varepsilon_o G\right)\frac{c^2}{m_P\left(4\pi\varepsilon_o G\right)}=\frac{1}{2}m_P c^2 \tag{93}$$

So one of Planck's dipole energy is

$$u_{PC}=\frac{1}{2}m_P c^2=\frac{1}{2}h\nu_P=\frac{1}{2}\hbar\omega_P \tag{94}$$

where ν_P is Planck's frequency, and ω_P is Planck's angular frequency, defined in this way

$$\omega_P=\sqrt{\frac{c^5}{\hbar G}} \tag{95}$$

$$\nu_P=\frac{c}{\lambda_P}=\frac{m_P c^2}{h}=\frac{\omega_P}{2\pi}=\frac{1}{2\pi}\sqrt{\frac{c^5}{\hbar G}} \tag{96}$$

with

$$\lambda_P=2\pi\ell_P=2\pi\sqrt{\frac{\hbar G}{c^3}} \tag{97}$$

Planck's wavelenght.
The energy (94) has been hypotesized by Planck for the first time, during the study of the problem of blackbody spectrum, and baptized *zero-point energy*. [22] In that background it is asserted that the energy density follows the law

$$\rho(\omega,T)=\frac{\hbar\omega^3}{\pi^2 c^3}\left(\frac{1}{e^{\frac{\hbar\omega}{K_B T}}-1}+\frac{1}{2}\right) \tag{98}$$

where the first term in brackets depends on the material aspect, of the emitter body inside the cavity, while the second term points out another energy that doesen't depend on the temperature. In the particular case, when the temperature vanishes, the spectrum won't be null but it still has a residual energy $E=\frac{1}{2}\hbar\omega$. This result represents a classic model to explain bodies' electromagnetic radiation emission and absorption, and it wouldn't be succesful if we didin't consider the zero-point field presence which is responsable of the zero-point energy.
Blackbody's study is based on Kirchoff's model, who believed in the universality of Blackbody's radiation, which depended only on temperature and frequency and it didn't depend on the emitting body's composition. Nevertheless observing different materials, Kirchoff observed different emetting spectra, which weren't connected to the changing temperature, while he observed that graphite was special, with a regular spectrum and with a connection to the temperature. So he chose the graphite's spectrum as reference model in radiative balance. But in this way there isn't universality absering that all radiative bodies behave in the same way, but we choose a specific blackbody as reference and referring to the other bodies to the reference body. This is a standardization process and not a universal law.

Coming back to our analysis, so the *medium Planck could represent Kirchoff's reference backbody*.

9 – The electron
Now we suppose the electron has to follow a symmetric coupling relation similar to Planck's particle, or

$$e\equiv\beta m_e \tag{99}$$

From the coupling constant α, and using the (31), we obtein:

$$\alpha = \frac{e^2}{q_p^2} = \frac{\beta^2 m_e^2}{Æ^2 m_p^2} = \frac{\beta^2}{Æ^2}\alpha_G \tag{100}$$

from which

$$\beta^2 \equiv \frac{\alpha Æ^2}{\alpha_G} \tag{101}$$

and so

$$\beta \equiv \pm Æ\sqrt{\frac{\alpha}{\alpha_G}} \tag{102}$$

Numerically we obtein

$$\beta = \pm\left(8{,}617\times10^{-11}\right)\sqrt{\frac{1}{137\cdot\left(1{,}762\times10^{-45}\right)}} = \pm\, 1{,}759\times10^{11}\ \left[\frac{C}{Kg}\right] \tag{103}$$

As we can note, β term we obtained from (103), which expresses the ratio e/m_e, is equal to the first relation of (20).

10 - Conclusion

The first thing that is affirmed in this analysis is that “vacuum” isn’t considered as lack of physical content (“empty”). Vacuum is Planck’s particles’ domain, which work in the vacuum and characterize the vacuum. It has been hypotized that Planck’s dipole is a stable and permanent system, making *Planck medium*, a cosmic background that would represent a "particular reference system" as to we refer to our measures. In every branch that studies physical laws in a medium, it refers to the medium’s features as to vacuum. If vacuum didn’t have a physical content this argument wouldn’t have a physical meaning.

On the other side, in the quantum theory and in the gavitation theory, we retain that vaccum has physical properties. The first attempt of vacuum concept was the ether, but Michelson-Morley’s experiment (1887) was null, so this concept was dropped. Its real nature was revealed by Planck in the *second quantum theory* [22] and in a series of following articles, where the oscillator has zero-point energy equal to (94).

In 1916 Nernst proposed that vacuum was filled of *zero-point electromagnetic radiation* [23]. In the development of general relativity, Einstein introduced the *cosmological constant* as the rapresentation of the *intrisic energy of vacuum space*. In the quantum theory the *zero-point energy* is required as a direct consequence of Heisenberg’s uncertainty principle. In 1948 Casimir [24] showed that a consequence of the *zero-point field* is a force that is exerted between the conducting plates.

The quantistic theory has changed the concept of vacuum, considering it as the *quantum field fluctuations place*, and these fluctuations revealed themselves in the macroscopic world. Although it is established that Planck’s constant mark the separation between classical and modern physic, nowdays few developments exist which explain classical phenoma considering Planck’s constant. Probably, this neglet comes from quantum theory existence which is the established orthodoxy, the best theory we have, running the risk to repeat the same mistake made during Newton’s mechanics revision.

This theory wants to be neither complete nor conclusive, but it is an attempt to renew the interest towards the classical mechanics, and to face the *wave-particle duality* from a different outlook.

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