New formulation of gravitational and electromagnetic interactions as originated by deformations in space-time and their implications in nuclear interactions

Modern physics is now in a similar point as the astronomy before Copernicus. Then, with every new observation it was necessary add new spheres to fit the theory to these new observations. Nowadays the same it is happening. With every new observations new dimensions new classes of matter and energy are introduced. It is time to change the point of view, move it from the Earth to the Sun to simplify and unify all the theories and discard those that are only mathematical constructions without clear relationship with reality.

An example of this possibility is shown here. A little change in definition of gravitation field g compatible with traditional gravitation theories give an explanation to observations that are explained with dark matter and dark energy. Supposing some elastic properties to the space gives a single cause explanation to gravity and electric forces as well as to nuclear interactions.

This example is not completely developed and furnish only calculation results in order of magnitude but it is enough to see that are according to presently known data.

Following Relativity Theory, the space can be deformed and recovers its former geometry if the cause of deformation disappears. This means that space has elastic properties. Deformation in elastic bodies can be in different ways. We will see that the four fundamental forces, gravity, electric as well as strong and weak nuclear interactions can be explained as coming from space deformations.

NEW FORMULATION OF GRAVITATIONAL AND ELECTROMAGNETIC INTERACTIONS AS ORIGINATED BY DEFORMATIONS IN SPACE-TIME AND THEIR IMPLICATIONS IN NUCLEAR INTERACTIONS

KEYWORDS: gravitation, MOD, electromagnetism, nuclear interactions, unification

1. ABSTRACT

The objective of this study is to show how the four fundamental forces can be originated by the same causes. It does not intend to reach an exact calculation of them, it is compatible with relativistic mechanics and quantum mechanics that are still essential as calculation tools. The study of gravitation is focused on the great distances, although based on the small ones, because the influence on the latter is considered irrelevant. Similarly, the study of electromagnetic forces is focused on small distances because it is considered irrelevant in long distances, although in both cases the same equations would be applicable.

From the assumed nature of these forces, several characteristics of matter and space can be deduced as the reason why the speed of light is independent of the reference system, the reason for the change of the neutrinos in one to another, the nature of the Higgs boson, the reason for the predominance of matter over antimatter and the possible existence of a wave faster than light.

The substitution of the concepts of mass and electric charge by deformations in space-time, allows to formulate in a different way both the equations of gravity and the forces between charges. This leads in a natural way to a calculation of these forces at very small distances in which they acquire values of the order of magnitude of the nuclear interactions. In this way, the four fundamental forces appear as originated by the same causes. In addition, the new formulation of gravity would justify both dark matter and dark energy.

2. BASIS OF THIS STUDY

We will try to describe the universe and the interactions between its parts based on the following basic assumptions:

1. The laws that govern the smallest are applicable to the greatest.
2. The universe has three spatial dimensions and one temporal.
3. Material objects have three spatial dimensions and a temporal thickness.
4. Mass is function of temporal thickness.
5. Every interaction between particles is originated by the geometry of space-time and its elastic properties.
6. The electric charge is a torsion deformation in space with a minimum radius.
7. This torsion is what provides stability to the particles, particles without electrical charge are unstable.
8. The four dimensions of space-time are quantized.

With these considerations one must be able to explain and calculate all the interactions between the components of the universe.

Before beginning to quantify, we will qualitatively see some properties derived from these assumptions.

We will use a diagram, figure 1, in which only a spatial dimension, x-axis, and a temporal dimension, y-axis are shown.

The ordinate distance D corresponds to a mass located at point 0. What is shown is the spatiotemporal deformation. For the origin it has a given time dimension and would asymptotically move away for a nonexistent x = -δ. This creates a "well" of deformation, depth or dimension D, at the point where the mass that gives rise to the deformation would be located.

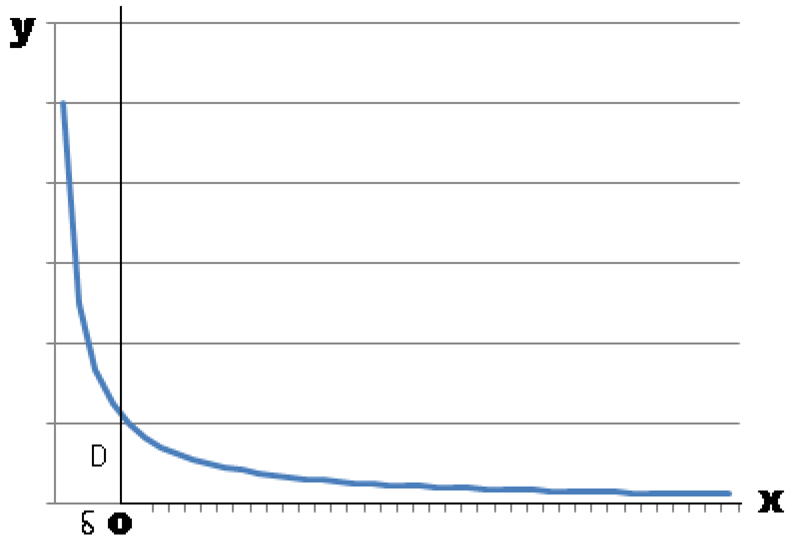

Figure 1. Space-time deformation versus distance.

In the following figure 2 this well of deformation is shown, corresponding to a particle, with two spatial dimensions, axes x and y, and the temporal dimension z.

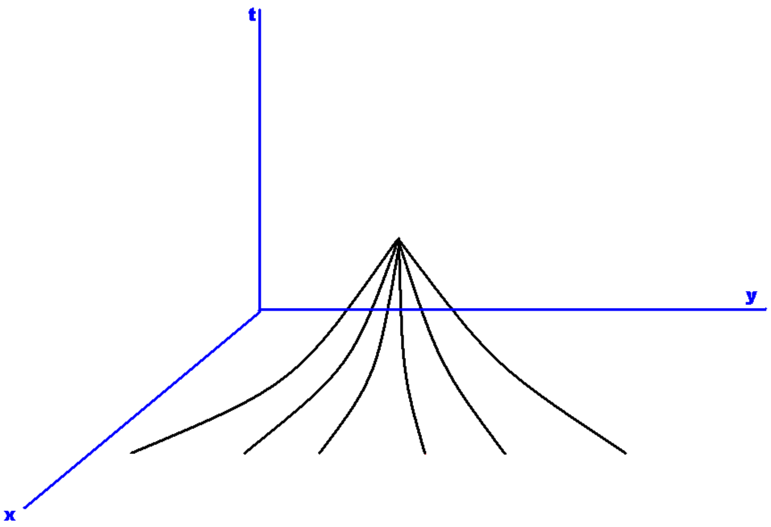

Figure 2 Space-time deformation versus distance adding one dimension.

In this figure, the lines of the same curvature module would be circumferences and we will call them iso-lines. In three spatial dimensions they would be spherical surfaces of the same curvature module and we will call them iso-surfaces.

A particle without mass has no temporal thickness, for example photons. Corresponds to a transverse wave that, in an elastic medium has a constant speed. Let's see what happens when the mass particle moves at a certain velocity "v".

The deformation well moves with the particle as a transverse wave so that it deforms by shortening in the direction of movement as the particle progresses and dilates in the direction opposite to the movement. In this way, if we consider that no deformation of the type of the well can advance faster than a transverse wave, a photon that was located in front of the particle in motion would seem to maintain the same speed with respect to the particle to contract the deformation temporal space. If it were located behind the particle, the same thing would happen when the deformation well dilated.

In any case, the speed of light would remain constant regardless of the movement of the particle. This consideration requires taking into account the relativistic mechanics in the calculations.

So far we have considered only two types of transverse waves and no longitudinal wave. Nowadays, longitudinal waves have not been detected, these waves would interact much more weakly with matter than neutrinos. In addition, in other elastic media, longitudinal waves have a higher speed than transverse ones, so if they exist, they could have a speed greater than that of light. If we rely on examples in other media, its speed could be of the order of $1.5c$ if similarity is kept.

The case of neutrinos deserves a separate consideration. We have assumed that, as uncharged particles, neutrinos must be unstable and decompose in a relatively short time. This consideration leads us to the conclusion that neutrinos have no real mass, which consist of transverse waves in a plane time, space. It means that the little interaction of these with matter, its speed, its absence of charge and its reduced mass indicate that neutrinos are oscillating deformations between tauonic, muonic and electronic neutrinos and their respective anti-neutrinos: $\nu_e \to \nu_\mu \to \nu_{\tau_\tau} \to \bar{\nu}_\tau \to \bar{\nu}_\mu \to \bar{\nu}_e$ and backward $\bar{\nu}_e \to \bar{\nu}_\mu \to \bar{\nu}_\tau \to \nu_\tau \to \nu_\mu \to \nu_e$.

The different apparent masses are the intermediate states of the oscillation although the average mass, the average deformation is zero, which allows its velocity to be extremely close to that of light. A neutrino could be considered a soliton. It seems essential to quantize the time so that there is not a large number of neutrino classes.

We have said that electric charge is actually torsion deformation in space with a minimum radius. We represent a possibility in figure 3 only in its projection in a two-dimensional space x, and without a temporal axis.

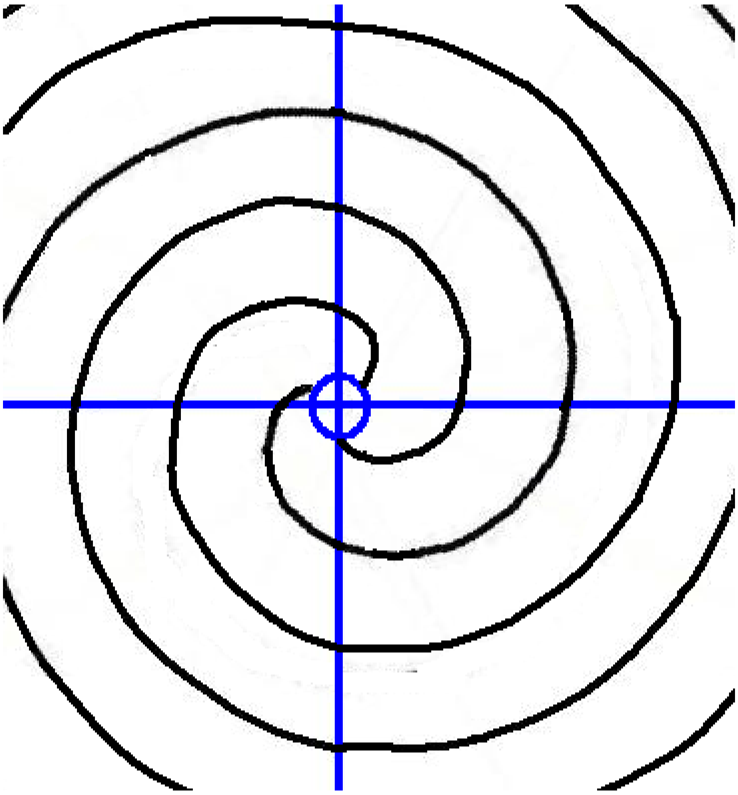

Figure 3. Deformation caused by torsion.

We have called ρ_0 to the minimum torsion radius. This torsion produces a curvature of the space in which the iso-surfaces also have spherical symmetry.

From these premises we will try to evaluate all the interactions between individual particles at very small distances and large masses at great distances that allow us to explain the observations of each other.

It will be seen that the concepts of mass and electric charge are unnecessary from the moment they can be replaced by the corresponding deformations in the calculation of their effects.

3. GRAVITATORY FORCES

Let us take two masses m_1 and m_2 as shown in figure 4. In an elastic medium the force between them will be proportional to increment of the distance between both masses considering the last distance that one measured in space-time and first one in x axe.

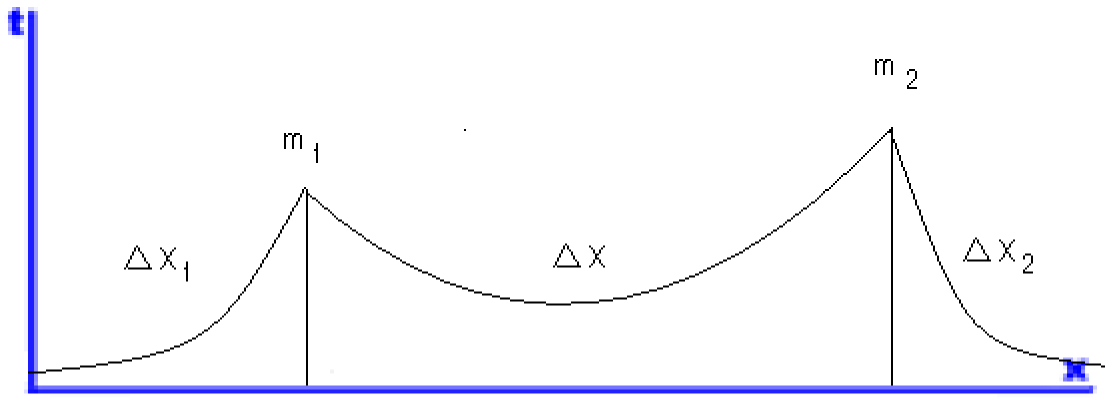

Figure 4. Deformation of x axe in presence of two masses.

In general, even if we have not the exact shape of the deformation, it will be possible to obtain an expression of this distance as a serial development like the following one:

$$D = x + C_1 + \frac{C_2}{x} + \frac{C_3}{x^2} + \frac{C_4}{x^3} + \cdots$$

Where $C_1, C_2, C_3, \dots, C_n$ depend on those masses. The increment of the distance would be $\varDelta x = D - x$.

$$\varDelta x = C_1 + \frac{C_2}{x} + \frac{C_3}{x^2} + \frac{C_4}{x^3} + \cdots$$

For very long x, we can take first three terms as approximation of $\varDelta x$.

$$\varDelta x = C_1 + \frac{C_2}{x} + \frac{C_3}{x^2}$$

The attractive force between these particles would be $F_a = k\,\varDelta x$

There will be a repulsive force between both masses proportional to the increments $\varDelta x_1$ and $\varDelta x_2$, $F_r = k(\varDelta x_1 + \varDelta x_2)$. So, the force between both masses is

$$F = F_a - F_r = k(\varDelta x - \varDelta x_1 - \varDelta x_2)$$

It is clear that $\varDelta x_1$ and $\varDelta x_2$ have a finite value and do not depend on x so can be considered as constants. Le tus say $C_1 - \varDelta x_1 - \varDelta x_2 = C_{1-2}$

$$F = k\left[\left(C_1 + \frac{C_2}{x} + \frac{C_3}{x^2}\right) - \varDelta x_1 - \varDelta x_2\right]$$

$$F = k\left(C_{1-2} + \frac{C_2}{x} + \frac{C_3}{x^2}\right)$$

We will look for another way to obtain the same results and easier to calculate those constant values. For this purpose we are going to introduce a new magnitude that we will call gravitational action $\boldsymbol{A_{g1}}$ as a vector following the line between both masses, adresed from m_2 to m_1 and with module such as

$$\frac{dA_{g1}}{dx} = \frac{\sqrt{G}m_1}{x^2}$$

In the same way, we would have $\boldsymbol{A_{g2}}$ and

$$\frac{dA_{g2}}{dx} = \frac{\sqrt{G}m_2}{x^2}$$

The force exerted by m_1 on m_2 will be a vector addressed from m_2 to m_1 and its module the scalar product $\boldsymbol{A_{g1}}.\boldsymbol{A_{g2}}$

$$F = \boldsymbol{A_{g1}}.\boldsymbol{A_{g2}}$$

$$\frac{d\boldsymbol{A_{g1}}}{dx} = \frac{\sqrt{G}m_1}{x^2}\boldsymbol{i}$$

$$\boldsymbol{A_{g1}} = -\frac{\sqrt{G}m_1}{x}\boldsymbol{i} + k_1\boldsymbol{i}$$

$$\frac{d\boldsymbol{A_{g2}}}{dx} = -\frac{\sqrt{G}m_2}{x^2}\boldsymbol{i}$$

$$\boldsymbol{A_{g2}} = \frac{\sqrt{G}m_2}{x}\boldsymbol{i} + k_2\boldsymbol{i}$$

Being $\boldsymbol{i}$ the unitary vector in x axe direction.

As the angle between $\boldsymbol{A_{g1}}$ and $\boldsymbol{A_{g2}}$ is 180º,

$$F = \boldsymbol{A_{g1}}.\boldsymbol{A_{g2}} = \left(-\frac{\sqrt{G}m_1}{x} + k_1\right)\left(\frac{\sqrt{G}m_2}{x} + k_2\right)$$

$$F = -\frac{Gm_1m_2}{x^2} - \frac{\sqrt{G}}{x}(k_2m_1 - k_1m_2) + k_1k_2$$

Similar to the former expression of F where $C_3 = -Gm_1m_2$, $C_2 = -\sqrt{G}(k_2m_1 - k_1m_2)$ and $C_{1-2} = k_1k_2$

Let us see the meaning of this equation having on account that now we are talking about great distances and great masses.

With appropriate k_1 and k_2 values, this expression of the gravitational force would explain both, dark matter and dark energy effects, increasing g at galactic distances and providing a repulsion force between highly distanced galaxies.

In other elastic systems t is also possible to obtain the force between two deformations as the scalar product of two vectors.

This figure 5 is a graph similar to the one that would take place choosing the values of $k_1$and k_2 to fit with observations of angular velocity and of expansion.

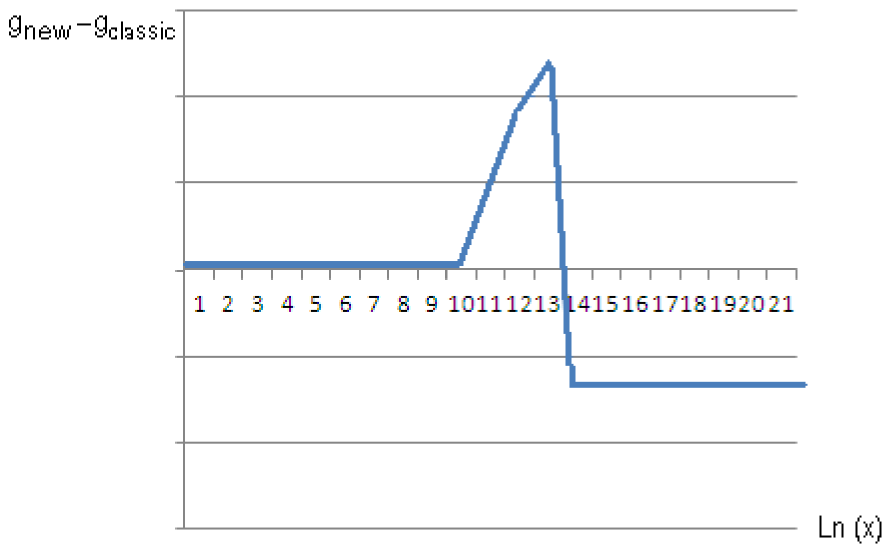

Figure 5. Δg versus logarithm of the distance.

4. THE HIGGS BOSON

We have not mentioned it before but it is clear that without the traditional concept of mass, the nature of the Higgs boson seems to be of accumulated time, a deformation without electric load that, therefore, must have a very short life.

The implications are that the traditional concepts of mass and electrical charge do not exist in reality but are deformations in a space-time of three spatial dimensions and a temporal one without the need for additional dimensions.

5. ANTIMATTER

Antimatter would be nothing more than the same deformations with opposite sign, that would explain the properties of the same as well as the mutual disintegration between matter and antimatter.

This theory also explains the abundance of matter over antimatter since in the initial moment of the Big Bang only matter could appear, not antimatter in our arrow of time. The antimatter could appear from a very small moment but enough for the asymmetry to occur.

6. ELECTRICAL FORCES

The electric charge is replaced by a torsion of the deformation around the time axis.

In terms of torsion, consider, for ease of representation, a two-dimensional space and the time axis as in Figure 1. If one of these wells undergoes an angle twist "α" around the axis of the temporal dimension, it originates a deformation in three-dimensional space whose curvature must follow a helical curve according to$\rho = K_3\vartheta$ where "K_3" is a constant. In general, the radius of curvature is not directed towards the well, but oscillates with center of the well center. Projecting on the x, y plane we have figure 6.

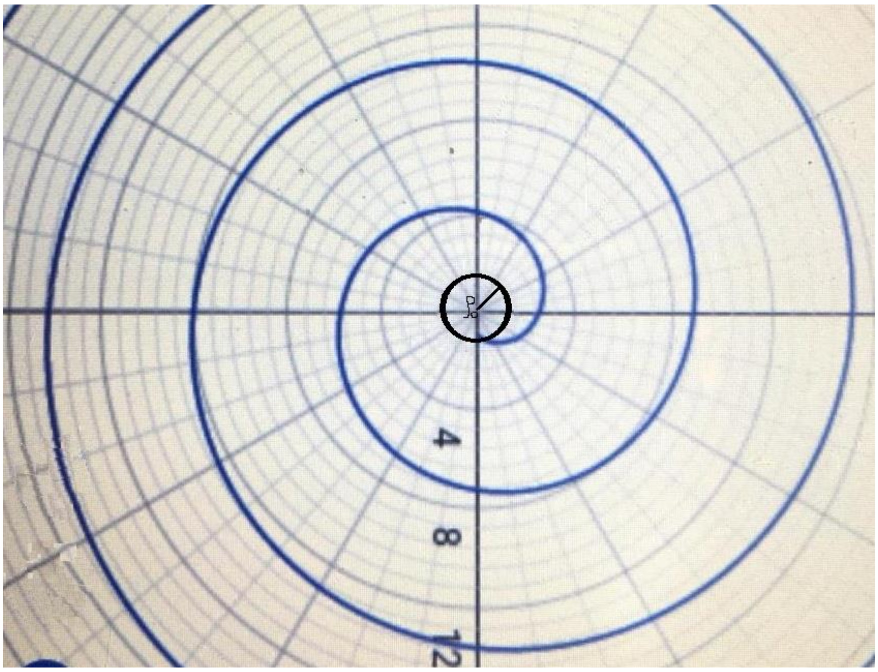

Figure 6. Torsional deformation curve

We consider that the torsion begins with a minimum radius ρ_0. Although in general the center of curvature does not coincide with the center of the well, if the well, besides the torsion is rotating with angular velocity ω, the surfaces of equal curvature – iso-surfaces - will be spheres of center the center of torsion, by Therefore, we can consider that the curvature field has a spherical symmetry. Thus, as happens in the gravitational case, the modulus of the vectors to be considered would also be inversely proportional to the distance and directly proportional to the constant K_3 and to the torsion angle α. If we have two torsions present, the vectors would be, as in the previous case, in the direction of the center of the deformation and of modules:

$$u_1 = \frac{K_3\alpha_1}{r-\rho_0}$$

$$u_2 = \frac{K_3\alpha_2}{r-\rho_0}$$

The strength between the two wells would be given by the same scalar product as before:

$$F = \frac{\pm k_3^2\alpha_1\alpha_2}{(r-\rho_0)^2}\cos\beta$$

In this case the sign of the scalar product is affected by both the signs of $\alpha_1$and α_2 as well as the angle of the vectors, which changes direction for $r < \rho_0$. Being an attractive force for $F < 0$ and repulsive for $F > 0$. As it is observed, it is the same law of attraction between electric charges for distances that are not very small.

Figure 7 shows, on the same scale as before, the comparison between this calculation and that of the classical theory for the case of charges of different sign. In Figure 8 the same comparison for charges of the same sign.

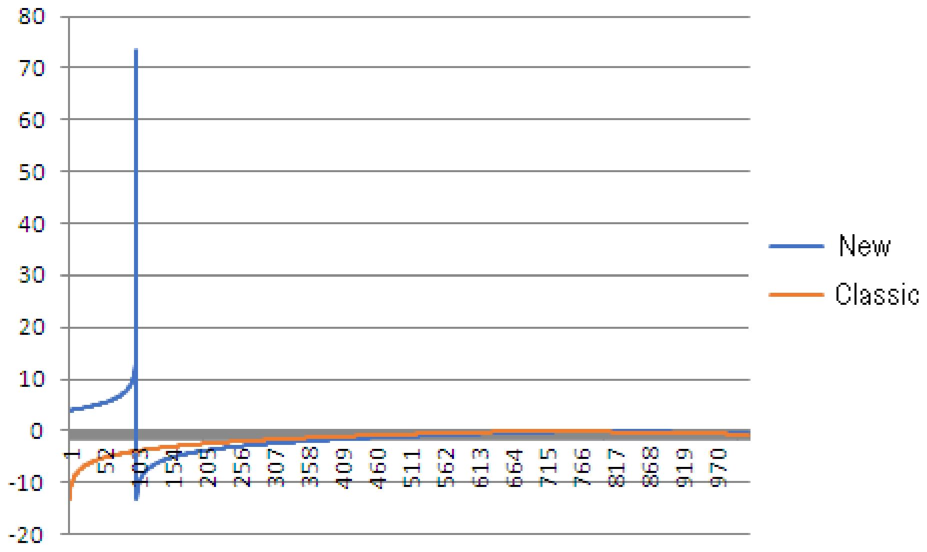

Figure 7. Electric forces between same sign charges at very small distances.

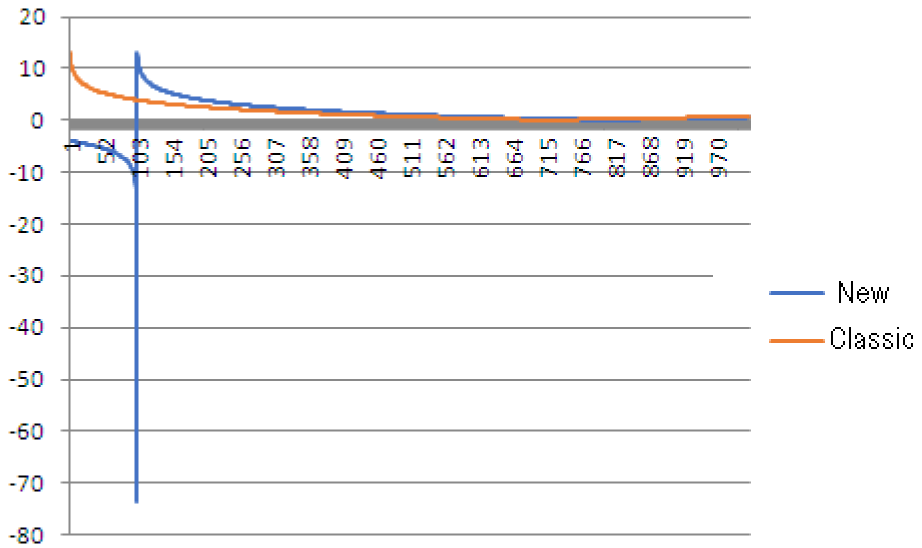

Figure 8. Electric forces between different sign charges at very small distances.

Considering these two forces as the only ones that act, the sum of both, in the two cases considered, are shown in figures 9 (charges of different sign) and 10 (charges with the same sign).

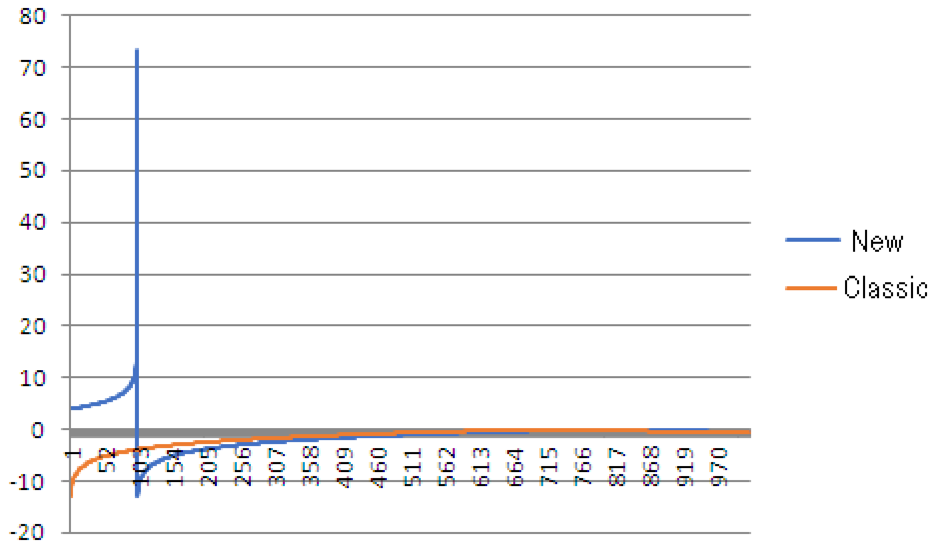

Figure 9. Electric plus gravity forces with different sign charges.

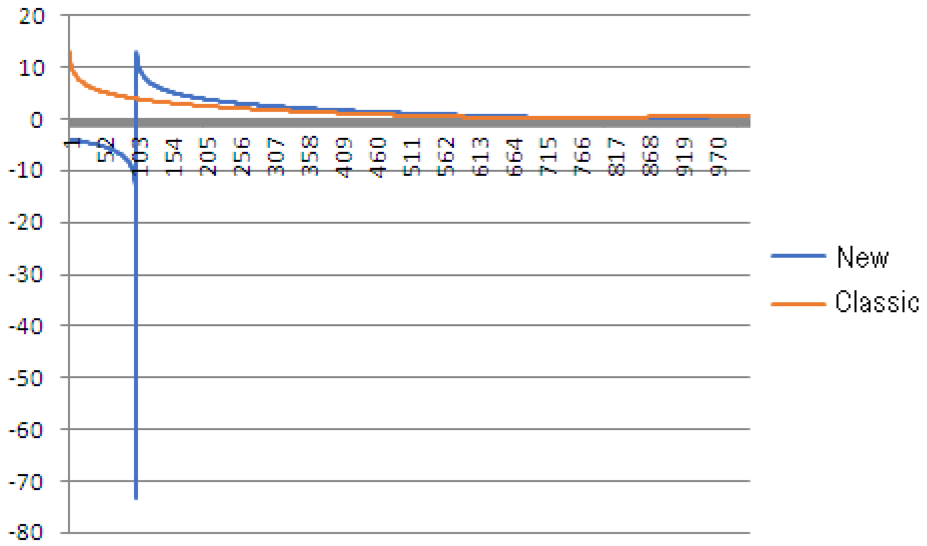

Figure 10. Electric plus gravity forces with same sign charges.

As expected, the influence of gravitational force is not appreciable. And the figures 9 and 10 are very similar to the 7 and 8. The greater peak would correspond to the strong nuclear interaction and between this one and the origin to the weak nuclear interaction in the distance in which this one is smaller than the sum of the forces classic.

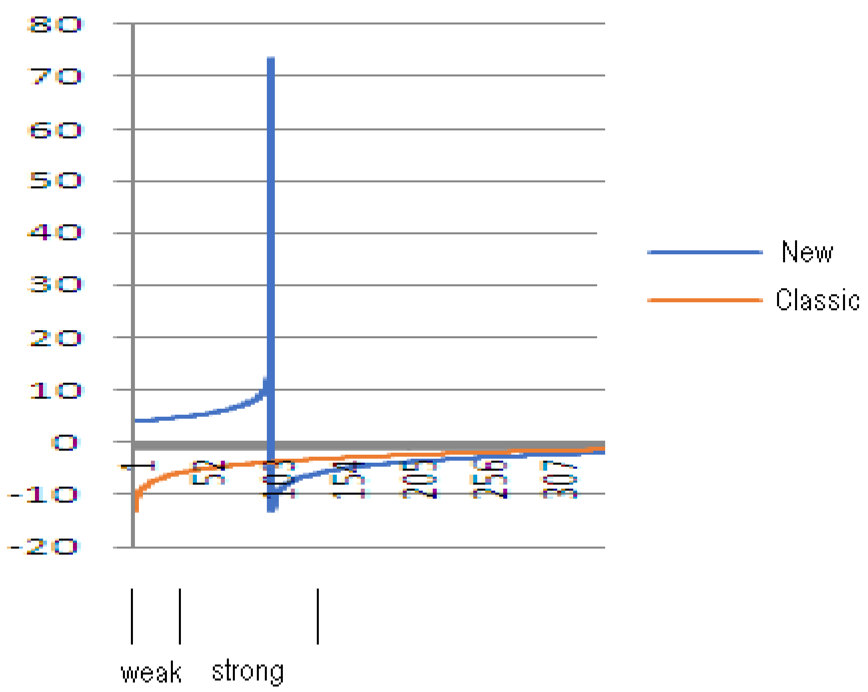

Figure 11. Strong and weak nuclear interactions.

The infinities that appear in this calculation, not shown in the figures, disappear considering a quantization of space. In the calculation we have considered a dimension of 10^{-30} m as the elementary quantum of space.

LIST OF FIGURES