The gravitoelectric nuclear energy

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Abstract

In the present work we assume that in the atomic nucleus the gravitoelectromotive force $\left(F_{ge} = \frac{GKMm}{R^2}\right)$ acts as responsible for the stability of nucleus and for the nuclear size, and that the potential energy related to this force be given by the ratio $\frac{F_{ge}}{2\pi R}$ with R equal to the nuclear radius observed in the electron scattering experiments, obtaining surprising outcomes.

The new approach offers an occasion for discussing about the physics and chemistry foundations, in particular about the meaning of the gravitational potential energy and about the nature of the atomic nucleus, which perhaps should be reconsidered in deterministic terms, rather than probabilistic ones.

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- **The nuclear radius and the gravitoelectromotive force**

The nuclear force acting within the atomic nucleus as responsible for the nuclear stability and for the cohesion of nucleons is, according to the nuclear standard physics, the strong nuclear force.

Though, there are some evidences that seem to deny the existence of this force.

First of all, if the strong nuclear force were responsible for the cohesion of the nucleons, it should explain the nuclear size, which instead still remains without a theoretical motivation.

Moreover, in the reference [1] it has been remarked that the strong nuclear force is denied by the radius 7 fm of halo neutron in Be11.

In the mentioned reference we can read that the inexistence of the strong nuclear force, inferred from an impartial analysis of what really happens in the alpha decay of U238, seems to have been confirmed in 2009 by an experiment, reported in the reference [2], because, while the range of maximum actuation of the strong force is less than 3 fm, the experiment has detected that a halo neutron in Be11 is separated from the rest of the nucleus by a distance of 7 fm.

By contrast, in the present work we show traces of the presence of gravity even within the atomic nucleus, as responsible for the nuclear stability and for the cohesion of nucleons.

We know from Einstein's theory of relativity that the energy contained in the atomic nucleus is equal to $E = Mc^2$, where M is the mass of the nucleus.

We will seek to demonstrate that the above formula is incomplete, and that, once completed with the missing part, it will appear entirely nude to us, without that halo of mystery that previously prevented us from seeing more deeply, showing that perhaps it does not denote the mass-energy equivalence principle proposed by Einstein's special relativity, but something else.

As it's known, the gravitational potential energy U of a mass body m subjected to the attractive force of gravity exerted by a mass body M is:

$$U = F_g * R \quad (1)$$

where F_g is the force of gravity $\frac{GMm}{R^2}$ and R is the distance between the centers of the two bodies (assumed as spherical).

Therefore the eq. (1) becomes (the value is considered as *positive* for the reasons explained below):

$$U = \frac{GMm}{R^2} * R$$

$$U = \frac{GMm}{R}$$

This is the gravitational potential energy of the mass body m, which is usually defined as the test body.

Actually, the traditional physics does consider the equation (1) as the potential energy of the test body provided that the force is assumed as constant, but this is only a way to simplify the calculation, because the force of gravity is not constant throughout the distance, then the gravitational potential energy should be determined by means of the integral of the force of gravity over the distance, in the same way as for the work.

Though, we will demonstrate that this is not true, and that the gravitational potential energy has to be determined, in the *macroscopic* world, by the product of the force times distance, because the aforesaid energy is conceptually different from the work, as we will clarify later.

First of all we have to demonstrate that the eq. (1) is true.

We know from the virial theorem (Clausius 1870) that the kinetic energy of an orbiting body subjected to the gravitational force has to be half its potential energy in order to have a stable orbit:

$$\langle E_K \rangle = -\frac{1}{2} * \langle \phi \rangle \tag{1a}$$

where $\langle \phi \rangle$ is the average over time of the potential energy of the test body and $\langle E_K \rangle$ is its average over time of the kinetic energy.

Since the gravitational potential energy U is traditionally considered as negative, the eq. (1a) becomes:

$$E_K = \frac{1}{2} * U \tag{1b}$$

Well, if the eq. (1) were true, then it would follow that the eq. (1b) should hold if we take as U the right-hand side of the mentioned eq. (1).

So, applying the eq. (1b) to the solar system, and considering M as the mass of the Sun, m as the mass of the planet, R as the semi-major axis of the planetary orbit and v as the mean orbital velocity of the planet, we have:

$$\frac{1}{2}\, mv^2 = \frac{1}{2}\, F_g R$$

$$\frac{1}{2}\, mv^2 = \frac{1}{2}\, \frac{GMm}{R^2}\, R$$

$$\frac{1}{2}\, mv^2 = \frac{1}{2}\, \frac{GMm}{R}$$

$$\frac{GMm}{R} = mv^2 \tag{1c}$$

Let's test now the eq. (1c) on Venus planet, because it has the least eccentric orbit among all the planet of the solar system, namely an orbit which is well-approximable to a circumference, and let's replace the numeric value of the mass, of the mean orbital velocity and of the semi-major axis of Venus in eq. (1c).

By knowing that:

- the mass m of Venus is $4.8675 * 10^{24}\ kg$

- the mass M of the Sun is $1.9891 * \ 10^{30}\ kg$
- the mean orbital velocity v of Venus is $35{,}020\ m/s$
- the semi-major axis R of the Venus' orbit is $108{,}210{,}123{,}792\ meters$

then the eq. (1c) leads to:

$$\frac{(6.6743 * 10^{-11}) * (1.9891 * 10^{30}) * (4.8675 * 10^{24})}{108{,}210{,}123{,}792} = 4.8675 * 10^{24} * (35{,}020)^2$$

$$5.9717 * \ 10^{33}\ joule = 5.9695 * 10^{33}\ joule$$

$$\frac{U}{mv^2} = \frac{5.9717 * \ 10^{33}}{5.9695 * 10^{33}} = 1.0003$$

The eq. (1c) holds and consequently the eq. (1) is true.

This definitely shows that the potential energy of the planets must be calculated not by means of the integral of the force of gravity over the distance, but by the product of force of gravity by the distance, as we wanted to demonstrate above.

The reason of the direct proportionality between the gravitational potential energy and the distance, which we have seen in the equation (1), rather than the inverse proportionality, which instead appears in the equation of the force of gravity, is explained by the fact that in the first case we observe the phenomenon of gravitational attraction in terms of *potentiality* of the body subjected to a given gravitational force and located, for example, at a certain distance from the center of the Earth, of accelerating towards the center of the planet.

It is obvious that the higher up the body is located, the greater its gravitational potential will be, because the velocity with which it will reach the center of the planet is the greater, the greater the distance from which it begins to fall is.

The force of gravity, in fact, acts continuously upon the planet throughout its trajectory and increases according to the inverse square law $\left(g = \frac{GM}{R^2}\right)$.

It is a logical consequence of this new vision of the gravitational potential energy, although improvable as we'll see later, that it has to be mathematically expressed as positive, unlike the traditional definition in which it is negative, because we have considered the movement of the test body in the same direction and sense as those of the force of gravity, whereas, in the traditional standard physics, the mentioned energy is understood as the capacity of a body subjected to the gravitational force of doing work, in particular the work is considered what is needed to move the body, for instance, from the Earth up to infinite, in which case the sense of the motion of the body is opposite to that of the force, and consequently the potential energy is taken as negative.

We can say in this regard that to think of the gravitational potential energy in terms of *capacity of doing work* is misleading, because a body located at a certain distance, for example, from the Earth, doesn't have any other capacity than that of falling towards the planet, not at all that of moving *on its own* against the force of gravity.

The capacity of doing work is something different from the gravitational potential energy, because the work, like the term itself evokes, denotes something to do in order to prevail over some acting (for instance a persisting force) or resisting (for instance the inertia) entity, which obstacles the movement of the body.

In a nutshell, and more precisely than our previous definition, it seems more appropriate to consider the gravitational potential energy as the potentiality of the test body m, placed at distance R from the attractor body M, of accelerating towards the center of the aforementioned attractor, respecting a precise law $\left(g = \frac{GM}{R^2}\right)$, which is different not only from the work to be done by an extern cause in order to overcome gravity and move the test body up to a certain distance from the center of the planet, but even from the work done by gravity itself to move the test body from its position to another specific point closer the planet.

In these two latter cases, in fact, we only determine the energy required to move a body from a point to another one, regardless the body's way of moving, whereas in the first case (gravitational potential energy) the way of moving of the body, in particular its way of accelerating, is taken as a fundamental element.

From these important differences one can deduce not only that the gravitational potential energy cannot be other than positive, since the movement of the body caused by the force of gravity cannot have other sense than that of the force, but mostly that the gravitational potential energy can be mathematically expressed even in a different manner from the way of expressing the work, by not being work.

An example will help us to clarify the previous statements.

Let's take two planets, respectively of mass M and $\frac{M}{4}$.

Be A and B two test bodies of equal mass m and suppose that A is located at distance $2R$ from the center of planet M, and B at distance R from the center of planet $\frac{M}{4}$.

The two test bodies are subjected to the same force of gravity:

$$\frac{GMm}{(2R)^2} = \frac{G\frac{M}{4}m}{R^2}$$

$$\frac{GMm}{4R^2} = \frac{GMm}{4R^2}$$

Yet, even though both test bodies experience the same force of gravity, and even if the test body A will impact the planet M with a velocity which is greater than twice the velocity with which the body B will impact the planet $\frac{M}{4}$ (because the velocity of the falling objects increases according to the inverse square law $g = \frac{GM}{R^2}$), despite this, the body A holds a potentiality of accelerating towards the center of the planet M which is exactly twice that held by the body B of accelerating towards the center of the planet $\frac{M}{4}$, because the space available for accelerating is, in the first case, twice compared to the second, and because both falling bodies accelerate towards the respective attractors according to the same law: $g = \frac{GM}{R^2}$.

Notice in this regards that the potentiality held by a body of accelerating throughout a certain space according to a specific law, is different from the potential maximum acceleration of that body, because the first is an energy, the second is a prediction of the amount of the acceleration, that is an acceleration.

In essence, the reason why the gravitational potential energy of a falling object is directly proportional to the distance R, as we have written in eq. (1), is that its possible maximum velocity increases as the distance increases, and that this increment happens according to a precise gravitational law.

The fact that in the macroscopic world the gravitational potential energy is mathematically expressed in the same way as the work (i.e. as the product of the force times distance) as we have done in eq. (1) is only an accident that should not mislead and induce us to think that they are the same thing, consequently it is not consistent with the aforesaid nature of the potential energy to determine its value by means of the integral of the force of gravity over the distance (since gravity is not constant), even if the integral were taken as positive, because the aforesaid integral expresses the *work* done by the force of gravity to move the test body in the same sense of the force until it reaches the center of the attractor body, which is conceptually different from the *potentiality* stored in the test body of accelerating throughout a definite space toward the center of the attractor body according to a precise law.

In fact there could exist, in principle, cases in which the force of gravity acts in such a way that the test body m, even if at rest, does not fall towards the body M, but revolves around it, and that the revolution be the slower, the greater the distance from the central body is, and in this case the gravitational potential energy should be formally expressed in a different way from the product of the force of gravity times distance, in particular by means of the ratio of the force over the circular trajectory covered by the body $\left(\frac{F_g}{2\pi R}\right)$, as we will show below.

We are referring to the atomic nucleus, within which we can hypothesize that there exists an attractive-repulsive gravitational *zone* (notice that we have used the term zone only in a spatial sense, in order to not to generate confusion with space-temporal *field* used in the theory of relativity) produced by the nucleons themselves which would give rise to a pendulum, in particular a peculiar harmonic oscillator which would imply the complete revolution of the nucleons around the fixed point, rather than the oscillation around the equilibrium point, with the particularity that these latter would be considered as *self-orbiting* particles, namely which stay simultaneously both in the center of the nucleus and in orbit around it, and presenting the following features:

1) the center of the nucleus would be the fixed point (*fulcrum*) of the pendulum, which would be occupied by the nucleons at rest, among which the gravitational force would be only attractive, under the assumption that neutrons neutralize the electrostatic repulsion among protons;
2) the central core made up of such aggregated nucleons would simultaneously produce attractive and repulsive gravitational forces upon their orbiting *alter-ego*;
3) the attractive force experienced by the aforesaid orbiting alter-ego of

nucleons would play the same role as that played by the tension of the wire in the Galilean pendulum;

4) the repulsive force experienced by the orbiting nucleons — equal in strength to the attractive force, but not aligned to it (having a non-radial direction) — would play the same role as that played by the force of gravity exerted by the Earth upon the Galilean pendulum, decomposing itself into two components, one radial component and one tangential component, the latter of which would represent the responsible for the movement of the pendulum (namely of the nucleons);

5) the letter g which appears in the formula of the period T of the harmonic oscillator $\left(T = 2\,\pi * \sqrt{\frac{l}{g}}\right)$ would be, in our model, the repulsive acceleration of gravity $g = \frac{GM}{l^2}$ experienced by the orbiting nucleons, which would play the same role as that played by the Earth's acceleration of gravity upon the pendulum, where the letter l, which denotes in the Galilean formula the length of the wire, in our model would represent the nuclear radius, which therefore will be replaced by the letter R from now on.

In such a particular harmonic oscillator it should happen that, by increasing the distance from the center of the nucleus, the repulsive acceleration of gravity g should decrease — unlike the Galilean pendulum in which, by increasing the length of wire, g increases, because the body approaches to the Earth's center — and consequently the formula of the potential energy should change.

If we admit, indeed, that the effect of the attractive-repulsive zone does not consist of making the bodies fall towards the central attractor-repulsor, but of making them move, even if initially at rest, around it at decreasing speed as the distance from the central body increases, according to the formulae of a pendulum in which g is inversely proportional to length of the wire squared (R^2), then it would follow that the equation of the gravitational potential energy would become as follows:

$$U = \frac{F_g}{2\,\pi R} \tag{2}$$

This time, differently from the eq. (1), the distance R is in the denominator, because, the greater is the distance, the lower the maximum linear velocity produced by the attractive-repulsive zone will be.

In fact, the period T of the nuclear harmonic oscillator would increases if the nuclear radius R increases $\left(T = 2\,\pi * \sqrt{\frac{R}{g}}\right)$, and in this case not only the angular velocity of the pendulum, but even its linear velocity (more precisely the tangential velocity) decreases, because above we have assumed that in such a particular type of pendulum the repulsive acceleration of gravity g, as well as the attractive one, decreases with the increase of the nuclear radius squared ($g = \frac{GM}{R^2}$).

In detail, the formula of the tangential maximum velocity of the nuclear pendulum harmonic oscillator would be $v = \omega * R$, and, by knowing that the angular velocity of harmonic oscillator is $\omega = \sqrt{\frac{g}{R}}$, its tangential velocity will be $v = \sqrt{\frac{g}{R} * R^2}$ $= \sqrt{\frac{GM}{R^3} * R^2} = \sqrt{\frac{GM}{R}}$ which demonstrates that, in such a particular pendulum, the increase of the wire (the nuclear radius) implies the decrease of the possible maximum tangential velocity of the oscillating (better saying revolving) body of pendulum.

In essence, the reason why the gravitational potential energy of a test body subjected to an attractive-repulsive gravitational zone, which is assumed to give rise to a pendulum harmonic oscillator generating a circular trajectory, is inversely proportional to the space covered ($2\pi R$), is that the possible maximum linear velocity caused by such a gravitational zone decreases as the distance increases, and that this reduction takes place according to the acceleration law of the harmonic oscillator $g = \omega^2 x$, where x is the projection of the position of the oscillating (better saying revolving) body onto the x-axis, consequently we can assert that the gravitational potential energy of nucleons can be defined as their potentiality of accelerating throughout a circumference of a certain radius R, according to the mentioned acceleration law, and that therefore this energy can be mathematically expressed as inversely proportional to the circular trajectory $\left(\frac{F_g}{2\pi R}\right)$ described by nucleons.

The term π appearing in the denominator of the eq. (2) is extremely important because from it one can deduce that it’s not the case of an exclusively repulsive zone, in which the potential energy should be inversely proportional to the rectilinear distance $\left(U = \frac{F_g}{R}\right)$, not to the circumference $\left(U = \frac{F_g}{2\pi R}\right)$.

But the equation (2) must still be modified if to be applied to the atomic nucleus.

Here, in fact, even if we admit that gravity acts, it would not be the only operating force, because it is not possible to neglect the electrostatic one.

Therefore I have supposed that in the nucleus the force of gravity and the electrostatic force were merged, giving rise to the *gravitoelectromotive* force F_{ge} having this magnitude:

$$F_{ge} = \frac{GKMm}{R^2} \tag{3}$$

where K is the Coulomb's constant and G is the gravitational constant (for now we leave out the dimensional analysis, faced in the next paragraph), so the eq. (2) becomes:

$$U_{ge} = \frac{GKMm}{R^2} * \frac{1}{2\,\pi R} \tag{3a}$$

where U_{ge} stands for gravitoelectric potential energy, in order to distinguish it from the gravitational potential energy, which is usually indicated with the letter U (this terminological difference is important because, like we will see in the next paragraph, the two energies are measured in two different, although equivalent, ways).

It's paramount to specify that we have assumed that the nuclear gravitoelectromotive force depends only on the product of the nucleonic masses, not even on the product of the charges, because the mass is the common element among nucleons (both protons and neutrons have a mass, but only the first have a charge).

Consistently with our assumption that nucleons are self-orbiting particles, namely that stay simultaneously in the center of the nucleus and in orbit around it, we have to replace in the above equation m — which denotes the orbiting body, having a very small mass with respect to the central one — with M, i.e. with the total mass of the nucleons itself, so that the equation (3a) becomes:

$$U_{ge} = \frac{GKMM}{R^2} * \frac{1}{2\,\pi R} \tag{4}$$

$$U_{ge} = \frac{GKM^2}{2\,\pi R^3} \tag{5}$$

where R is the nuclear radius detected in the electron scattering experiments: for medium and heavy atoms, $R = 1.21 * \sqrt[3]{A}\,fm$, where A is the mass number (see references [3]).

Now, in order to mathematically demonstrate that this energy is operating within the atomic nucleus — deferring to later any further investigation concerning the dimensional analysis — we have to verify if the energy expressed in eq. (5) is equal to Mc^2, i.e. the total mass-energy of nucleons, so we can write:

$$\frac{GKM^2}{2\,\pi R^3} = Mc^2 \tag{6}$$

It's important to specify that M is taken as the mass of the nucleus, intended as the sum of the masses of the protons and of neutrons, without taking into account the binding energy (mass-defect), that therefore will not be subtracted from the mentioned sum.

Let's test now the eq. (6), considering the nucleus of bromum atom (^{79}Br), which contains 35 protons and 44 neutrons, whose radius — according to the empirical formula $R = 1.21151 * \sqrt[3]{A}\ fm$ — is 5.1983 $femtometers$:

$$\frac{(6.6743*10^{-11})*(8.9875*10^{9})*\{[(35*1.6726)+(44*1.6749)]*10^{-27}\}^2}{2*3.1415*(5.1983*10^{-15})^3} = [(35*1.6726)+(44*1.6749)]*10^{-27}*c^2$$

where c is the speed of light in vacuum: $299{,}792{,}458\ m/sec$

$$1.1884*10^{-8}\,joule = 1.1884*10^{-8}\,joule$$

$$\frac{U_{ge}}{Mc^2} = \frac{1.1884*10^{-8}}{1.1884*10^{-8}} = 1 \tag{6a}$$

For summary reasons it's not worth reporting here the above calculation for all the atoms, since the empirical formula of the nuclear radius seen above $\left(R = 1.21151 * \sqrt[3]{A}\ fm\right)$ is applicable to every medium and heavy atom.

The only further atom that we can consider as a demonstration of the validity of the eq. (6) is the lead atom, the heaviest among the stable atoms.

The nucleus of the lead atom contains 82 protons and 126 neutrons, and its radius, according to the mentioned empirical formula $R = 1.21151 * \sqrt[3]{A}\ fm$, is 7.1781 fm, hence, applying the eq. (6), we obtain the following values:

$$\frac{(6.6743*10^{-11})*(8.9875*10^{9})*\{[(82*1.6726)+(126*1.6749)]*10^{-27}\}^2}{2*3.1415*(7.1781*10^{-15})^3} = [(82*1.6726)+(126*1.6749)]*10^{-27}*c^2$$

$$3.1295*10^{-8}\,joule = 3.1293*10^{-8}\,joule$$

$$\frac{U_{ge}}{Mc^2} = \frac{3.1295*10^{-8}}{3.1293*10^{-8}} = 1.00005$$

The eq. (6) holds again.

Returning to our aim of demonstrating if there exists any other case in which the gravitational potential energy can be mathematically expressed in a different way from work (namely differently from the product of the force of gravity times distance), we think we have achieved the goal, because the expression $U_{ge} = \frac{F_g}{2\,\pi R}$, which leads to the eq. (5), has a different configuration from the work, where instead the space appears in the numerator ($W = F * S$), and it is quite implausible to believe that the value expressed by the right-hand side of the eq. (5) not to express an energy, by being exactly equal to the numerical value of another energy (Mc^2), and, we ask, which kind of energy could it be if not the gravitoelectric potential energy, by having we used in the aforesaid equation the gravitational constant and the Coulomb's constant?

We reiterate that M which appears in the formulae (5) and (6) is taken as the total mass of nucleons, intended as the sum of the masses of protons and of neutrons, without taking into account the mass-defect detected in the nuclear reaction experiments and ascribed, by the nuclear standard physics, to the binding energy of nucleons, which therefore here has not been subtracted from the mentioned sum of the nucleonic masses, and, despite this, the equation (6) perfectly holds, and this seems to demonstrate that the mass-defect detected in the nuclear reactions is not the consequence of the mass-energy equivalence principle stated by Einstein's special theory of relativity, but most likely is ascribable to the increase of the nuclear radius.

In other terms, from the relevant mathematical findings achieved in eq. (6), it seems possible to infer that the mass of an unbound nucleon (proton or neutron) is not greater than that of a bound nucleon, but is exactly the same, and that the discrepancy detected in the nuclear reactions is not due to the mass defect of a bound nucleon with respect to a free nucleon, but is the consequence of the very probable increase of the nuclear radius occurring during the nuclear reactions which in turn implies, according to the eq. (5), the decrease of the nuclear potential energy (assuming that the velocity of nucleons, c, remains constant), which is very likely responsible for what is detected in the nuclear reactions and interpreted, perhaps mistakenly, as the mass-defect by the nuclear standard physics.

The model here proposed, moreover, allows to explain also the weak binding energy of nucleons detected in the experiments: if we admit, in fact, that in the nucleus a pendulum arises, we know that in this latter the force of gravity, during the oscillation of pendulum, is not radial, and therefore decomposes itself into two components, one radial and another tangential, and the first, smaller that the tension of the wire, is the cause of the weak binding of nucleons.

In other words, the repulsive gravitoelectromotive force decomposes itself into a radial component and a tangential component, and the first one, by opposing the attractive gravitoelectromotive force, makes the nucleonic bond so weak.

- **The gravitoelectromotive force seen in the light of the dimensional analysis: comparison with the electromotive force**

According to the dimensional analysis, the force that in eq. (3) we have supposed to be existing in the atomic nucleus should not be a force, because it scales as the square of a force over a charge times the meter squared or, in units of the International System, as $\left(\frac{N}{C}\right)^2 * m^2$, and the gravitoelectric energy would be measured in $\left(\frac{N}{C}\right)^2 * m$.

This is an obvious problem that arises every time a new force is discovered, therefore the only way to solve the impasse is to create a new unit of measurement for the gravitoelectromotive force.

To this purpose we have to proceed in the following way.

By knowing that $\frac{N}{C}$ is the unit of measurement of the electric field strength, and that $\frac{N}{C}$ is equivalent to $\frac{V}{m}$ (where V is the *Volt*, and m the meter), the expression $\left(\frac{N}{C}\right)^2 * m^2$ becomes:

$$\frac{V^2}{m^2} * m^2 = V^2$$

The gravitoelectromotive force, hence, is measured in *Volt* squared, that we will define the *Ronap* (R).

$$1\ R = 1\ V^2$$

This is not inconsistent with the particular nature of the gravitoelectromotive force, because the *Volt* is the unit of measurement of the similar electromotive force, and its square is justified by the fact that the gravitoelectromotive force acts upon the same body that produces it, in essence, is a self-interacting force.

Consequently the potential gravitoelectric energy U_{ge} is measured in $\frac{Ronap}{meter}$ $\left(\frac{R}{m}\right)$ [see the equation (2)],which, from the numerical identity showed in the eq. (6a), must be equal to 1 *Joule*:

$$1\,J\ = \frac{1\ R}{1\ m} = \frac{1V^2}{1m}$$

Now it is necessary to define a new specific unit of measurement for the gravitoelectric energy, the *Ronapmeter (RM)*, which is equal to $\frac{V^2}{m}$, in turn equal to 1 $Joule$.

$$1\,J\ = 1\ RM$$

This reasoning presupposes that the electromotive force be considered as a force, albeit this is not the prevalent opinion in the current physics, because it is measured in $Volt$, that is equal to $\frac{N}{C} * m$, which is different from the unit of measurement of the force, i.e. the Newton.

Commonly, the electromotive force is intended as work, but its unit of measurement is different from that of the work ($N * m$).

So, if it is not a force, and if it is not work, what is it?

From the present study we can infer that, more likely, it is a force.

Let’s see why.

The electromotive force arises every time the electric current passes through a conductor, in particular it’s the cause of this flow.

But what is the object of the flow?

What is passing through the conductor?

Particles or only charges?

It has been experimentally shown that the drift velocity of electron in a circuit is too slow (in the copper, for instance, is $2.3 * 10^{-5}\ m/sec$) to justify the velocity of the electric current, which flows close to the speed of light.

This means that the electric current is not a flow of charged particles, but is a stream of charges, without any movement concerning the mass of the particles.

Consequently we can say that the electromotive force is a force in the sense that it regards only the charges, namely it makes possible their movement through the particles of the conductor: the mass, in other word, is not the object moved, but is the medium in which the object (the charge) moves.

In contrast, the Newtonian force, like the gravitational one, makes the mass move in the space, even in vacuum, and even if the mass is charged.

If one uses a woolen cloth for rubbing a glass, this latter will lose superficial electrons and will become electrically positive, and despite this it will fall towards the Earth's ground if we let it free to fall.

Analogously, the electrostatic force makes the charged mass move, even in the vacuum, without the arise of any electric current.

In other words the electrostatic force acts upon the mass, provided that it is charged, so the charge is not the object upon which the aforesaid force acts, but is the necessary condition for the force to act upon the mass.

And the gravitoelectromotive force?

If we look at its formula $\left(F_{ge} = \frac{GKMm}{R^2}\right)$ we think that it is more similar to the gravitational force or to the electrostatic one, but if we look at its dimensions, (the $Volt$ squared), we think that it is more similar to the electromotive force, which is measured in $Volt$.

The gravitational force and the electrostatic force are measured in Newton because they makes possible the movement of the mass in space ($Kg * \frac{m}{sec^2}$), whereas the electromotive force and the gravitoelectromotive force make possible the stream of charges in a conductor, with the difference that, in the first case, the flow occurs in the particles of the conductor body, which is different from the source of the electromotive force (this is particularly evident in the case that an electric current is caused by a moving magnet approaching to, but not colliding, a closed circuit), whereas, in the second case (gravitoelectromotive force), the electric stream occurs through the particles of the electric source itself (the atomic nucleus), because electric source and conductor coincide, and this is the reason why this force is measured in Volt squared.

In essence, like we will see better in the next paragraph, the nucleus is a natural gravitoelectric generator, in particular a self-interacting system in which the gravitoelectric source and the conductor coincide, and, we repeat, this is the reason why the unit of measurement of the gravitoelectromotive force is the Volt squared.

We can hypothesize that, in this natural gravitoelectric generator, the orbiting neutral alter ego of nucleons generate, by virtue of their extremely high velocity (of light), a spin of the central charged core, and that this spin produces a magnetic field; this field interacts with the orbiting nucleons, giving rise to the gravitoelectric current in the nucleus itself, characterized by two gravitoelectromotive forces simultaneously acting on the orbiting nucleons, since we have said that the nucleus is a self-system in which the gravitoelectric source and the conductor coincide: one force attracts the orbiting nucleons towards the central core, and the other one pushes the aforesaid particles far apart from the nucleus, although in non-radial direction, thus forming a pendulum.

In this regard it is important to report here an important discovery [11], in which it has emerged that the nucleus generates a weak magnetic field, confirming the theory here proposed.

So we can conclude that, in the atomic nucleus, the gravitoelectromotive force simultaneously acts upon the mass and upon the charge of the nucleons, thus generating a gravitoelectric current, hence it is different from the electric current, which produces exclusively a flow of charges, without any displacement of mass.

In particular the difference relies the fact that the gravitoelectric current is a flow of the neutral alter egos of nucleons, yet this alter egos are not different and separated particles with respect the central charged core, but are the same particles duplicated, which flow at the speed of light around the central core, forming a sort of circuit, so we can say that the gravitoelectric current constitutes a flow of charge and mass simultaneously, whereas the electric current is only a flow of charge.

And the gravitoelectromotive force is different even from the electrostatic force, because this latter causes the displacement only of the charge, as an indirect effect of the force, which acts directly on the mass, provided that it is charged, whereas the gravitoelectromotive force acts directly both upon mass and upon charge, simultaneously.

The gravitoelectric current, therefore, is different from the electric current, and this is the reason why the first is not detectable by a galvanometer.

Due to this difference between the electromotive force and the gravitoelectromotive force, we need a new specific unit of measurement for the second one, that we have defined above as the $Ronap$ (equal to the $Volt$ squared).

The square of the Volt depends on the weirdness of the structure of the nucleus, because, beyond being a gravitoelectric source and a conductor simultaneously, we will see later that the nucleus is a self-system even in the sense that the nucleons are charged and neutral at same time, and are at rest and in orbit at same time.

This is the only way to avoid to claim, quite unrealistically, that the numerical identity seen in eq. (6a) is only a fortuitous coincidence.

In conclusion we can say that the units of measurement of the forces, and consequently of the energy associated to them, do not need to be always the same, because the *modus operandi* of the force and the object upon which the force acts can change case by case.

In addition, the equation of the gravitoelectromotive force $\left(F_{ge} = \frac{GKMm}{R^2}\right)$ is not so strange, because the nucleus, although also contains neutrons, is globally charged, therefore the presence of the Coulomb constant together with the gravitational constant is perfectly and logically explainable, despite the force does not depend on the product of the charges.

The mathematical identity seen in eq. (6a) is so perfect that an underlying physical meaning must subsist beyond any reasonable doubt, by being quite unconceivable to simply assert that one deals with a mere accident.

But what is this underlying physical meaning of the eq. (6)?

In the next paragraph we'll try to discuss this issue.

- **Are nucleons self-orbiting particles?**

The result achieved above gives rise to a philosophical question.

How to interpret the eq. (5)?

In other words the fact that the energy expressed by the eq. (5) depends on the mass of nucleons squared could have a precise physical meaning, in particular could mean, as anticipated above, that the nucleons stay both in the center of the nucleus and, at *same time*, in orbit around it, because we have replaced in eq. (5) the mass m — which denotes the orbiting body, having a very small mass with respect to the central one — with the mass M, that is the total mass of nucleons.

If we accept this assumption, there would be non-irrelevant consequences on the foundations of physics, because this would mean that the nucleons would not be everywhere, as the probabilistic vision of quantum mechanics proposes, but would be only in two specific points and conditions simultaneously (at rest and revolving), always having, even before the measurement, a precise position, trajectory and velocity in while they are orbiting about the center of the nucleus (occupied by their alter ego at rest).

In this weird scenario, one should accept not only the idea that the nucleons stay in two places at the same time, but also the fact that they are both at rest, in the center of nucleus, and revolving at same time around this point, with the further specification that, when they are moving, they would do at the speed of light at a distance equal to the nuclear radius.

In this framework, in fact, the right-hand side of the eq. (6) would be twice the kinetic energy of the nucleons ($2 * \frac{1}{2} Mc^2 = Mc^2$).

From the planetary orbits, indeed, we know that the orbit will be as stable as possible whether the gravitational potential energy will be equal to twice the kinetic energy of the planet.

In our solar system we have in particular that, as we will demonstrate in the next paragraph, the following relation is operating for each planet:

$$\langle U \rangle \; = \; 2 \, \langle E_k \rangle \tag{7}$$

Where $\langle U \rangle$ is the average over time of the potential energy, $\langle E_K \rangle$ is the average over time of the kinetic energy ($E_k = \frac{1}{2} m v^2$, where m is the mass of the planet), by approximating the planetary orbit to a circumference with radius R equal to the semi-major axis of the planetary orbit.

By having we demonstrate above that U is equal to $F_g * R$, then the eq. (7) becomes:

$$F_g * R = 2\left(\frac{1}{2}mv^2\right) \quad (7a)$$

$$m * g * R = mv^2$$

$$g * R = v^2$$

$$\frac{GM}{R^2} * R = v^2$$

$$\frac{GM}{R} = v^2$$

$$v = \sqrt{\frac{GM}{R}} \quad (8)$$

(where M is the mass of the Sun) which is notoriously the velocity required to have a circular orbit, namely the most stable orbit.

From the eq. (6) it is possible to derive the theoretical formula of the speed of light c:

$$c = \sqrt{\frac{GKM}{2\,\pi R^3}}$$

which is not very different from the planetary orbital velocity seen in eq. (8).

Furthermore in a recent research [4] it has been experimentally shown that the missing momentum of a knockout proton, in some collisions, can be up to 1,000 Mev/c, in contrast with the previous experiments, from which the value of the missing momentum turned out to be 250 Mev/c.

The value of 1,000 Mev/c is very high and could be well-justified by assuming that the nucleons move within the nucleus at the speed of light, or at a speed which is approaching it.

Moreover, in the mentioned research it has been shown that in the nucleus not only an attractive force exists, but also a repulsive force, and it is very likely that these two opposed forces are not aligned (in the sense that only the attractive force would have a radial direction), and this consequently gives life to the particular pendulum descripted in this work, which guarantees the dynamical equilibrium of nucleonic orbits.

In this regard it is important to remark the similarity of the nuclear model here proposed with the interatomic and intermolecular chemical bond, by being the balance between attractive and repulsive forces a fundamental feature of all these systems (see reference [8]).

We can conclude that the nucleus is a natural generator of gravitoelectric current (see previous paragraph) which is charged and neutral at same time, and orbiting around itself.

- **Is the virial theorem always valid?**

As we have already synthetically anticipated above, the virial theorem (by R. Clausius, 1870) states, for a central potential $\langle \phi \rangle (\vec{R}) = \phi\ (R) \propto \pm\ R^{\pm b}$, that:

$$\langle E_K \rangle = \pm \frac{b}{2} * \langle \phi \rangle \tag{9}$$

where $\langle \phi \rangle$ is the average over time of the potential energy, $\langle E_K \rangle$ is the average over time of the kinetic energy and b is the exponent of the radius as it appears in the formula of the potential energy.

Since the gravitational potential energy is inversely proportional to the distance $\left(U = \frac{GMm}{R}\right)$, then the exponent of the radius is $b = -1$ and the eq. (9) becomes:

$$\langle E_K \rangle = -\frac{1}{2} * \langle \phi \rangle$$

Yet, in the light of the findings reached in eq. (6), whose left-hand side denotes quite indisputably the nuclear potential energy, the virial theorem [eq. (9)] doesn't hold.

Indeed, applying the eq. (9) and considering that the nuclear gravitoelectric potential energy is — as expressed in eq. (5), even though considered as negative like the traditional way of thinking — inversely proportional to R^3, the virial theorem would lead to:

$$\langle E_K \rangle = -\frac{3}{2} * \langle \phi \rangle$$

$$\frac{1}{2}\ Mc^2 = -\frac{3}{2} * \left(-\frac{GKM^2}{2\,\pi R^3}\right)$$

Multiplying both sides by 2:

$$Mc^2 = \frac{3GKM^2}{2\,\pi R^3}$$

which is not true.

In fact, if we again apply the above equation to the bromum atom ^{79}Br, it leads to:

$$\frac{Mc^2}{\frac{3GKM^2}{2\,\pi R^3}} = \frac{1.1884 * 10^{-8}}{3.5652 * 10^{-8}} \neq 1$$

At this point, the fact that the virial theorem doesn't hold for the nuclear gravitoelectric potential energy can be explained in two different ways.

The first is to assert that the eq. (5) doesn't contain the nuclear potential energy, and consequently that Mc^2 wouldn't represent twice the kinetic energy of nucleons, but would be, as the theory of relativity states, the total mass-energy of nucleons, more precisely the energy that the nucleons contains for the very fact of having a mass, even if they are at rest.

This interpretation, yet, doesn't allow to explain which would be the physical meaning of the perfect mathematical identity given by the eq. (6), which consequently should be ascribed, we repeat, only to the fortuity, nothing short of unrealistically.

The second possibility is to claim that the virial theorem, as formulated in eq. (9), is incorrect, and that the correct *law* would be:

$$\langle E_K \rangle = \frac{1}{2} * \langle \phi \rangle \tag{10}$$

where ϕ is the gravitational potential energy, taken as positive for the reasons stated above, and intended as the potentiality held by the body m, subjected to a gravitational attractive force or to two simultaneous gravitational attractive-repulsive forces, respectively exerted by an attractor or by an attractor-repulsor body M, of accelerating towards respectively the center of the attractor body (assumed spherical) or around the center of the attractor-repulsor central body (assumed again spherical), throughout a certain space and according to a precise law.

This interpretation is based on the fact that the virial theorem is an *ad hoc* solution, valid only in the case that the force of gravity be inversely proportional to the square of the distance and that the gravitational potential energy be proportional to R^{-1}.

Though, this is a fact that has never been explained logically, mathematically or geometrically, in essence scientifically, in particular nobody has never demonstrated the reason why the force of gravity can't be other than inversely proportional to the distance squared, and that the gravitational potential energy can't be other than proportional to R^{-1}.

Consequently one can argue, in principle, that, if the gravitational force were, for instance, inversely proportional to the fourth power of the distance, the theorem would fail, as we'll show shortly.

In fact, in the case that the force of gravity were $F = \frac{GMm}{R^4}$, the kinetic energy needed to have a stable orbit, applying the virial theorem, would turn out to be greater than the potential energy.

In particular, supposing that in the mentioned hypothesis the force of gravity be only attractive, then the gravitational potential energy, taken negative as traditionally done, would be:

$$U = -\frac{GMm}{R^4} * R = -\frac{GMm}{R^3}$$

Consequently the exponent of the radius that would appear in eq. (9) would be $b = -3$, so that the necessary condition to have a stable orbit would turn out to be:

$$\langle E_K \rangle = -\frac{3}{2} * \langle \phi \rangle$$

$$\frac{1}{2} mv^2 = \frac{3}{2} * \frac{GMm}{R^3}$$

but this is impossible because the kinetic energy of the mass body m would be greater than its potential energy ($E_K = 1.5 * U$), and we know that in such a condition the orbit will be hyperbolic.

The same result would turn out in the case that the force of gravity were inversely proportional to the third power of the distance, in which case, applying the virial theorem, the most stable orbit would occur if the kinetic energy were equal to the potential energy, but it is well-known that in this case the orbiting body would reach the escape velocity, so the virial theorem would fail again.

The virial theorem, therefore, is implicitly based on two premises (namely the fact that the force of gravity can't be other than inversely proportional to the square of the distance, and that the gravitational potential energy can't be other than proportional to R^{-1}) which are not logically demonstrable, and this implies that it cannot be considered a *theorem* in the proper sense of the term, because a theorem is, by definition, a proposition which can be scientifically demonstrated, and this obviously holds even for its logical premises.

Consequently one should admit that the eq. (9) would be replaced by the eq. (10), and that this latter would apply in any case, both when the object (body or particle) is subjected to only one attractive gravitational force, and when it is subjected to two gravitational forces (attractive and repulsive) at same time, regardless of the mathematical configuration of the potential energy (namely, regardless of the exponent of radius, b, appearing in the formula of the potential energy).

In other words, in this scenario one should admit that the eq. (10) be a fundamental principle of Nature, in the sense that it wouldn't have any mathematical derivation, but should be accepted as it is.

After all, there are some aspects of the force of gravity that are not entirely explainable, just think of the fact, we repeat, that it depends, without any apparent logical reason, on the inverse of the square — rather than on the inverse of the cube or of the fourth power — of the distance, or rather than simply on the inverse of the distance.

However the aim of this paper is not getting into the details of the debate between those who believe in the existence of the fundamental laws of Nature, and those who believe that the physical laws are created by humans to describe the reality and consequently that every natural law should be explainable in the light of the reason, but it's undeniable that the answer to the question here proposed depends on the way of solving this dispute.

The only thing that I can say in this regard is that the deductive method doesn't seem the best way of approaching the force of gravity, as it is shown by the paradoxical results of the virial theorem seen above.

The inductive method, on the contrary, by starting from single cases in order to deduce, case by case, the existence of a general principle [in our case, that expressed by the eq. (10)], seems to be more suitable to study the issues related to the force of gravity, which, as for every phenomenological entity, is not *a-priori* knowable in its every single aspect.

For clarity, we report below the equations (6) and (1c), in order to show their absolute resemblance:

As regards the nucleonic orbit [eq. (6)]: $\frac{GKMM}{2\,\pi R^3} = Mc^2$

As concerns the planetary orbits [eq. (1c)]: $\frac{GMm}{R} = mv^2$

These two equations are evidently two specific applications of the general principle contained in the eq. (10), which for convenience is reported below multiplying both sides by 2:

$$\langle \phi \rangle = 2 * \langle E_K \rangle$$

The inductive method characterizes all branches of natural science (as biology, chemistry, medicine and so on), and there are no reasons for physics to represent an exception to this modus operandi, whereas there are obvious reasons for which only mathematics and geometry — which do not fall within the natural sciences but are the product of the human intellect — to be subjected to the deductive method.

Mathematics and geometry, in fact, are self-reliant disciplines, in the sense that they do not need to find a confirmation in Nature, but it suffices that they be logically impeccable.

But Nature does not care about our sense of logic, our sense of mathematical elegance: it behaves according to its sense of beauty, that could be different from ours, and, in my modest opinion, we should look at Nature with more respect and humility.

After all, those, like Einstein and many other physicists, who attempted or attempt to treat the force of gravity as an abstract geometrical entity, by finding its logical primary cause in the spacetime, in particular in its curvature, inevitably fall into contradiction, by *postulating* that the magnitude of this force is not explainable in the light of reason, accepting it as it is, namely implicitly supposing that it cannot be other than inversely proportional to the square of the distance, and with a related potential energy which is implicitly supposed as necessarily not different from the product of the force times distance, without any geometrical, logical, mathematical, scientific explanation justifying these two points too.

- **Relative facts and absolute self-facts**

In the reference [5] the authors distinguish relative facts from stable facts, and conclude that the stable facts are only a subset of the more general category of relative facts.

According to this theory, called relational quantum mechanics (RMQ), relative facts are even those concerning the particles that are in two superimposed states, or even the particles that are demonstrated to be ubiquitous, which instead are stable according to quantum mechanics because they are ubiquitous as ubiquitous the decoherence is.

In essence, according to RQM, "*Schrodinger's cat has no reason to feel superimposed*", because this situation is similar as the man in Einstein's elevator, which doesn't feel that the elevator, in which he stays, is moving in the interagalactic space (where the absence of gravity is assumed) with uniform linear accelerated motion, but thinks that the elevator is coming up and that he, together with the lift, is subjected to the gravitational force.

No matter what the observer sees, the important thing is what the observed feels, what he perceives.

Consequently, if Schrodinger's cat doesn't feel any change after the measurement, then it means that, to cat, nothing has changed, in the sense that, after the measurement, it feels to be in a single state and doesn't perceive any difference with respect to the superimposition situation in which it was before the measurement.

If nothing has changed, it means that no wave function collapse has occurred.

A logical corollary of this fundamental conclusion is that a fact is absolute when the relationality is not possible, namely when observer and observed *coincide*.

In particular it is possible to arrive at the conclusion that no wave function collapse occurs even by assuming that the equation (5) expresses the potential energy of self-orbiting particles (nucleons).

In this framework, in fact, we have assumed that the nucleons revolve around themselves, but this means that the nucleons are observers and observed at same time.

In particular, the orbiting nucleons are revolving particles with respect to their central alter ego, but these latter are not different and separated particles from the orbiting ones: are the nucleons themselves.

Analogously, the central nucleons are at rest with respect to their orbiting alter-ego, but these latter are not different and separated particles from the central ones: are the nucleons themselves.

We can conclude, hence, that the nucleus constitutes a self-system, meaning that the nucleons are observers and observed at same time, and, in this case, the relationality isn't possible anymore.

In fact, claiming that every system is always relative to another one, and consequently that it cannot ever be absolute, holds until observer and observed are different and separated objects or systems, but obviously doesn't apply when observer and observed coincide.

In this particular case, we deal with systems (more precisely self-systems) originating absolute facts, because the relationality, as necessary requisite for a fact to be relative, lacks.

If the nucleons constitute a self-system originating only absolute facts, it means that their wave function cannot collapse, because absolute facts, by definition, cannot collapse, and this is the reason why we are able to see the proofs of this superimposition, as we'll see later.

Finding the evidences of superimposed states is fundamental to demonstrate that this phenomenon truly occurs even before the measurement.

In other words, are we really sure that two entangled photons or electrons are superimposed before measurement?

The question arises because, when we measure (namely observe) one photon entangled to another photon, both of them are never found superimposed, in the sense that the entangled photons manifest themselves in only one state (for instance showing only the spin “up” or only the spin “down”), even if opposed with respect to each other, but never in two states simultaneously.

But the fact that there is the absolute certainty that, when we measure a photon, the non-observed entangled photon has the opposite spin with respect to the observed photon doesn’t necessary mean that the two photons were superimposed before measurement, and that, due to the measurement, they have collapsed in only one status, because we can also reasonably argue that the two photons were moving in that strange, entangled way even before the measurement, meaning that they were moving in such a way to have in every instant an opposite spin with respect to each other, namely changing their spin continuously and specularly, instant by instant, hence it’s obvious that they always show opposite spin after measurement.

Moreover, in order to have the absolute certainty that the two photons were superimposed before the measurement we should observe them in this superimposed state.

Well, in this regard we can say that the nucleons represent a case in which this is possible.

Indeed it has been shown that the nuclear size is bigger than that resulting from the electron scattering experiments.

In particular it has been demonstrated, see reference [6], that a beam of incident particles hitting a target nucleus is both diffracted and absorbed, and, when the absorption is maximum, the scattering cross section and the absorption cross section are identical, so that the total cross section, given by the sum between the two cross sections, is twice the scattering cross section.

In particular the particles beam is 50% diffracted and 50% absorbed, meaning that the nuclear dimension is twice that detected in the scattering experiments, and that the innermost part of nucleus is positively charged, whereas the outermost part is neutral.

This can be well-explained, we repeat, by assuming that the nucleons are self-orbiting particles which are globally charged in while they are at rest and, at same time, electrically neutral in while they are in orbit.

In essence, the nucleons are in a double superimposed state, namely, they are both at rest and, at same time, in orbit, with the specification that, they are (positively) charged when they are at rest, and neutral when in orbit; obviously all these considerations holds under the assumption that the electrostatic repulsion among the central protons be neutralized by the neutrons.

And these two superimpositions are both of them detectable in the experiments, descripted in the mentioned reference [6].

But in order to justify the cited experiments in the light of the gravitoelectromotive force and gravitoelectric energy proposed in this paper, it's necessary to modify the eq. (5) as follows:

$$U_{ge} = \frac{4GKM^2}{\pi R^3} \tag{11}$$

So the eq. (6) becomes:

$$\frac{4GKM^2}{\pi R^3} = Mc^2$$

In this way we obtain a nuclear radius $\left(R = \sqrt[3]{\frac{4GKM}{\pi c^2}}\right)$ which is exactly twice the radius observed in the electron scattering experiment, and therefore we manage to explain the real, total size of the nucleus resulting from both the electron scattering phenomenon and the absorption phenomenon descripted in the reference [6], provided that we assume that the gravitoelectric current, made up of orbiting nucleons, to be electrically neutral and that the electrostatic repulsive force among the central protons is neutralized by the neutrons, but accepting the eq. (11) implies to accept the *containing-energy* concept as defined in the reference [7], where it is clarified the reason of the adjunct of 4 in the numerator and the lack of 2 in the denominator of eq. (5).

But why can we detect only superimposed states concerning nucleons and not even those concerning photons, or in general, entangled particles?

This question has two possible answers.

The first is to think that the wave function of nucleons, as we have already said, cannot collapse because it involves objects which originate only absolute facts.

The second is to think that the wave function doesn't physically exist, in the sense that it is only a mathematical artifice and, consequently, the superimposed states which are not detected, but only supposed, have to be considered inexistent until they are experimentally demonstrated.

After all, "entangled" doesn't mean superimposed, but just means "united", "linked" to each other, in the sense that, by measuring only one particle, also the other is immediately affected.

As regards the feature of particles' ubiquity, which is shown in the double slits experiment, again it doesn't mean that these particles are superimposed, because being everywhere doesn't mean being simultaneously in two superimposed, *opposed* states.

Being superimposed means being in two contrary states in the same instant, namely two states which contradict one another, for instance at rest and in movement, charged and neutral, dead and alive, but if a particle moves towards two slits, and passes simultaneously in these two slits, it doesn't mean that the particle was superimposed, but only that, in while it was moving towards the slits, it was not concentrated in only one point, but was everywhere, yet this is a different situation from the superimposition paradox, and can be also explained by resorting to the pilot wave concept of De Broglie-Bohm.

In this way it is also possible to explain the spherical shape of the nucleus, resulting by the experiments, very likely caused by the pilot wave generated by the orbiting neutron, which revolve in circular orbit around the center of the nucleus, which would be the center of the resulting sphere.

Anyway the aim of the present paper is seeking to give a response only to the superimposition paradox in microscopic mechanics, and how to understand when it occurs, so we don't go here in the details of the debate concerning the possible interpretations of double slits experiment, which, we repeat, denotes weirdness, not paradoxicalness.

The only thing that we can say in concluding this study is that considering the nucleons as objects originating absolute facts can represent a useful tool to conceptually motivate not only the fact that they remain superimposed even after the measurement as well as to elucidate the experiments reported in reference [6], but even to justify some other absolute facts.

In particular, if we accept the existence of self-systems, then we should accept even that the facts they produce can't be other than absolute, for instance the constancy of the speed of light, which is independent from any observer.

The endorsement of the idea that the photons can produce absolute facts could be supported by arguing that they are in a certain way related to protons, in particular if we think about the possibility that their mass could be equal to the proton mass squared, as it is better shown again in the reference [7].

In this regards, in the references [9] and [10] it has been remarked that the value of the theoretical mass of the photon is $< 2 * 10^{-54}\, kg$, which is not very far from the value of the proton mass squared:

$$(1.6726 * 10^{-27})^2 = 2.7975 * 10^{-54}\, kg.$$

Obviously the mass of photons will be measured in $Kilograms$ (Kg), not in $Kilograms$ squared (Kg^2), because the square of the mass is only a mathematical way to express a numerical value, not a substantial element from which to infer the abstract validity or invalidity of the inference.

In other words, applying the empirical inductive method as we have suggested above, we can assert that, if Nature has imposed that the photon must have a mass which is numerically equal to the proton mass squared, like it seem to be shown in the reference [9] and [10], no abstract human rules can preclude this.

Induction, indeed, implies intuition, followed by the numerical confirmation.

- **Conclusions**

Through a new vision of the gravitational potential energy, intended as the potentiality stored in a body m, subjected to one gravitational attractive force, or to two gravitational attractive-repulsive forces simultaneously acting upon it, respectively exerted by an attractor, or by an attractor-repulsor body M, of accelerating respectively towards the center of the attractor body (assumed spherical) or around the center of the attractor-repulsor central body (assumed again spherical), throughout a given space and according to a precise law, and assuming that nucleons are self-orbiting particles, namely revolving around themselves, and supposing that the orbiting alter-ego of nucleons are neutral and subjected to two simultaneous gravitoelectromotive forces (where the gravitoelectromotive force is intended as the force acting on the charge and on the mass simultaneously, and measured in $Volt$ squared, equal to the $Ronap$), one attractive and one repulsive, both generated by the nuclear central core made up of charged nucleons at-rest, and hypothesizing that this attractive-repulsive *zone* would give rise to a harmonic oscillator which would cause the movement of the nucleons like a body hanging by a pendulum, it has been possible to demonstrate that the force of gravity acts in the atomic nucleus, even if in its electromotive variant $\left(F_{ge} = \frac{GKMm}{R^2}\right)$.

Even though some physical aspects of the just described nuclear model still remain not very clear, for example the weird fact that the aforesaid harmonic oscillator does not oscillate around the equilibrium point, but revolve around the fixed point (the nuclear center), as well as the odd fact that the gravitoelectromotive repulsive force would have a non-radial direction, and even though, consequently, it is not absolutely certain whether the gravitoelectromotive force be one, only attractive, or two, attractive and repulsive at same time, nevertheless it seems quite indisputable that the gravitoelectromotive force acts within the atomic nucleus as responsible for its dimensions and then for the cohesion of nucleons, by being the numerical value of the gravitoelectric potential energy of nucleons, found in our research, exactly equal to the numerical value of Mc^2, which could lead one to conclude that in the atomic nucleus a typical law of the macroscopic world be operating, namely the fact that the gravitational potential energy of the orbiting body has to be twice its kinetic energy in order to obtain a stable orbit, but, in this case, one should admit that the expression Mc^2 not to denote the total mass-energy of nucleons, as the special theory of relativity states, but to express twice the kinetic energy of nucleons, and then the foundations of chemical physics regarding the atomic nucleus, as well as those concerning the theory of relativity itself, could be questioned.

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