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The Nuclear Clock Correction for Universal Gravitation

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Abstract

Science is losing some fixed references shifting from universality to relativity: time and space become space time, the meter is related to the velocity of light and the second is fixed by the ticketing of a Cesium atom. In the case of Gravity, Nature was so friendly to Newton to allow him the writing of the Universal Gravitational Law, that changed the view of the Universe for the last three centuries. However, the way matter generates Gravity was unknown to Newton and the problem is still nowadays ignored by most scientists and remains the ultimate question mark of physics. We paid attention to the ticketing of all existing nuclides and found that the parameters of the neutron-proton transformations are so precise, in describing these reactions, that can be considered universal constants. Instead, the emitted neutrino flux ***Fo*** is almost constant with a mean value of 6.668E20 neutrino per gram and second over the wide range of all nuclides with some deviation for lighter nuclei. This is the reason why Newton was able to find his Universal Gravitational Law and allows us today to state a relation of this flux with the Gauss constant G on the basis of nuclear properties. Moreover, it explains the mechanism that bodies use for their mutual attraction with a simplification of the three-body problem in celestial bodies computation. We have to remember that Newton model, with a fixed gravitational Gauss constant G, or the equivalent with a fixed neutrino flux ***Fo***, have been used for the determination of the mass of the celestial bodies in motion with the implicit assumption that the gravitational and inertial mass are the same. In this paper we recognize the big difference in composition of the Sun and the gaseous planets compared to the terrestrial ones and show how the relatively small difference of the neutrino flux can change our vision of the Universe.

Keywords

Physics, Gravity, Astrophysics, Grand Unified Theory, Nuclear Bond, Neutrino, Particle Physics

1. Introduction

We have been educated to find and maintain fixed milestones, not to lose our way in the investigation of the world we live in.

We continue using the second with reference to the revolution of the Earth around the Sun but we know that the revolution time increases of some second fraction each year and that somebody adjusts in secret the world clocks, to avoid some possible disaster.

We continue to ignore why this happens [1], but changed our reference, defining the second on the basis of fundamental properties of nuclei with cesium nuclear clocks.

The meter was defined in terms of a prototype meter bar and now formally redefined as the length of the path travelled by light in a vacuum in 1/299,792,458 of a second.

Special Relativity used time as a variable coordinate of a moving body, similarly to the space coordinates, with the meter changing in relation to the speed, only the speed of light in vacuum being constant.

General relativity recognized that vacuum does not exist given that space is filled with gravitational effects and velocity of light changes locally with the gravitational field [2] [3].

The Newton Universal Gravitational Law were ready to die, to be replaced by Einstein field equation.

These equations are however so complex that all technicians and even scientists prefer using Newton for practical purposes, not disregarding the classical meter and second.

This happens when forcing Nature into mathematics, instead of using mathematics for investigating the mechanisms hidden under natural phenomena.

Newton was the inventor of differential calculus, but when he tried to use his equation of motion with his gravitation equation, he failed and left the famous three-body problem unresolved till nowadays [4].

Einstein hoped that a complex mathematics could explain the nature of Gravity, with a curved time space surface and produced a fascinating picture, hardly described by mathematics [3].

That is why Newton equation remains a basic milestone of science in its original form:

$$\mathbf{F} = GM_1M_2/R^2 \tag{1}$$

In addition to space and time, we have mass that is supposed constant in Newton equation: the masses of the Sun and of planets have been derived using Newton equation together with the mesurements of their trajectories and the principle of equivalence of gravitational and inertial mass.

The Gauss constant G measured by Cavendish remains the basic tool to shape the universe, to compute the mass of the Earth, of the Sun and of all the planets.

However, Newton himself was deeply uncomfortable with the concept of action at distance and confessed that "*I have not yet been able to discover the* *cause of these properties of gravity…It is enough that gravity does really exist and acts according to the laws I have explained, and that it abundantly serves to account for all the motions of celestial bodies* [5].”

In what follows we will try to solve this dated enigma, re-proposing our view of how Gravity works at distance and showing how it changes the shape of our Solar System.

2. Gravity Hidden in the Dynamic Motion of Nuclear Atoms

The fact that gravity is related to the presence of mass suggested that we had to move our investigation far away from the sky and from macro phenomena, toward the microscale of nuclear particles that constitute the ultimate component of matter [6] [7].

We were attracted by the neutrino, proposed by Enrico Fermi [8] to explain beta decay, for its elusive nature, similarly to Gravity, that everybody claims as a major component of the universe, but nobody is able to capture or identify due its null interaction with matter.

For the neutrino we assume a temperature of 2.0362˚K a wavelength λ of 0.14232 cm, an energy 1.38557E−15 erg or 8.71E−04 ev and an equivalent mass μ = 1.55277E−36 g that is a particle at a temperature lower than that measured in the universe of 2.725˚K for Cosmic Microwave Background.

The neutrino crosses a receiving body without interactions and in particular freely crosses the nucleons of the body, interacting only with the neutrino emitted by the nuclei of the body.

We suppose for a moment that a flux of neutrino $\boldsymbol{Fo}$ per gram and second is emitted from a body almost independently from its nature.

When a flux of neutrino comes, for example, from the Sun of mass M_1 to our Earth of mass M_2, it impinges on the cross section of the nucleons of the Earth, sums up with the nucleon emitted flux in all directions and gives rise to the attractive pull with an unconventional momentum balance.

In other words, the Earth increases the neutrino flux in the direction opposite to the Sun while the neutrino entering the Earth from the Sun subtract to those exiting the Earth in the direction of the Sun.

The neutrino flux around the Earth appears shaped similarly to the deformed space of Albert Einstein, with the difference that we have substituted a model with a physical phenomenon, with real matter and momentum balance involved.

The neutrino flux per unit surface at distance R from the Sun with mass M_1 is:

$$F = \boldsymbol{Fo} M_1 \big/ \left(4\pi R^2\right) \tag{2}$$

The cross section of the Earth is the number of nucleons (protons and neutrons with mass m_n) M_2/m_n, multiplied by the nucleon cross section πr_n^2.

We can therefore write the Newton universal gravitational law (1) in terms of nuclear parameters as follows:

$$\mathbf{F} = \left(\boldsymbol{Fo}\mu c r_n^2 / 4 m_n\right) M_1 M_2 \big/ R^2 = G M_1 M_2 \big/ R^2 \tag{3}$$

where c is the speed of light and $G = 6.668\text{E}{-}08$ is the Gauss constant ($\text{cm}^3 \cdot \text{s}^{-2} \cdot \text{g}^{-1}$).

One can easily compute ($\mu c r_n^2 / 4 m_n$) = 1.E−28 ($\text{cm}^3 \cdot \text{s}^{-1} \cdot \upsilon^{-1}$). and discover that the elementary neutrino flux needed is $\boldsymbol{Fo}$ = 6.668E+20 neutrino per gram per second ($\upsilon\, \text{g}^{-1} \cdot \text{s}^{-1}$).

The Gauss constant G and Fo are directly related:

$$G = \boldsymbol{Fo} \mu c r_n^2 / 4 m_n = 1.\text{E} - 28 \boldsymbol{Fo} \tag{4}$$

This strictly relates gravitation to intrinsic properties of matter and is not surprising because gravity is a property of matter and more specifically of nuclei.

We analysed all known nuclides [6] [7] and discovered that the neutron-proton distribution is not a casual one, but appears shaped by Nature for the benefit of Newton and disregarding his complains of the unknowns hidden in his equation.

Enrico Fermi [8] in the theory of beta decay assumed the following nuclear dynamic transformations of protons p, neutron n and electrons/positrons β:

$$\begin{array}{ll} \beta^- \text{ emission} & n \xleftrightarrow{k_1} p + \beta^- + \nu \\ \beta^+ \text{ emission} & p \xleftrightarrow{k_2} n + \beta^+ + \nu \\ \text{Orbital electron capture} & p + \beta^- \xleftrightarrow{k_3} n + \nu \end{array} \tag{5}$$

If we assume that these reactions are valid for all nuclides and, knowing the half-life of neutron, make a regression to fit the parameters k to the proton and neutron distribution of unstable and stable existing nuclides, we find:

$$k_1 = 0.0009625,\ k_2 = 4.71554\text{E} - 06,\ k_3 = 0.00105382 \tag{6}$$

The accuracy of this fit is such that we could view these parameters as universal constant for gravity similarly to the atomic clock for time.

We use these constants to compute the rate of emitted neutrino Foi/ai, per gram and second for all known radioactive and stable nuclides with ni neutrons, pi protons and atomic mass ai (g)

$$Foi = \frac{\mathrm{d}\nu i}{\mathrm{d}t} \Big/ ai = \frac{+k_1 ni + k_2 pi^2 + k_3 pi}{ai} \tag{7}$$

The mean value Fo over all existing no elements can be easily computed

$$\boldsymbol{Fo} = \sum_1^{no} Foi / no \tag{8}$$

We discover that it is almost constant for all nuclides with a mean value of Fo = 6.668E+20 neutrino per gram per second and this value does not significantly change from light to heavy nuclides with the higher defects for the first elements of the periodic table.

This is surprising, because we are recovering the physical meaning of gravity, that Newton was looking for, and we can apply this concept to every phenomenon on the Earth and in the sky: the annual delay of the Earth in its trip around the Sun can be explained [1], light regains in Gravity its new *ether* [2] and the three-body problem can be solved in the calculation of the motion of celestial bodies [4].

The *quasi* constancy of ***Fo*** and consequently of G should not create big problems if we consider that we use the product $F = \boldsymbol{Fo}M$ in our calculations but we have to remember that we have used Newton equation to establish the masses of the Earth, of the Sun and of the other planets.

If the flux F is correct and ***Fo*** varies, M should accordingly change and here we consider only the small variations of ***Fo*** due to the very different composition of celestial bodies.

In the following paragraph we give a snapshot of the new shape of the solar system and we try to discover the real masses M of the Sun and planets hidden under Newton equation.

3. Newton Equation and the Planets of the Solar System

When Newton wrote his fundamental law of gravitation, he did not consider that the two largest planets, Jupiter and Saturn, have nearly the same chemical makeup as the Sun; they are composed primarily of the two elements hydrogen and helium, with 75% of their mass being hydrogen and 25% helium. The heavy elements and rocks are supposed to sink to the center due to gravity and are considered a small fraction of the mass. Uranus and Neptune are much smaller than Jupiter and Saturn, but each also have a helium and hydrogen atmosphere and may have too, a small core of rock, metal, and ice.

The terrestrial planets are quite different from the giants. In addition to being much smaller, they are composed primarily of rocks and metals. Earth, Venus, and Mars all have roughly similar bulk compositions: about one third of their mass consists of iron-nickel or iron-sulfur combinations; two thirds is made of silicates.

Before Newton the mass of the planet where unknown and he used his equation together with Kepler relations to measure the size of all the bodies of the Solar System.

As an example, we can compute the mass of the Earth M_E on the basis of its known gravitational acceleration $g = 9.8\ \text{cm/s}^2$:

$$\mathbf{F} = mg = GmM_E / R_E^2 \tag{9}$$

where m disappears in agreement with Galileo experiment of the fall of bodies of different nature, and the radius of Earth R_E can be measured with precision and its knowledge that dates back to Eratostene.

When the mass of the Earth is known, we can determine the mass of the Sun, again using Newton, once known, for circular orbit, by astronomical measurements the distance between Earth and Sun R_{SE} and the Earth speed V_E.

$$\mathbf{F} = M_E V_E^2 / R_{SE} = GM_E M_S / R_{SE}^2 \tag{10}$$

Alternatively, we could use the third law of Kepler

$$M_S := \left(4\pi 2 a_E 3\right) / P_E 2G - M_E \tag{11}$$

where a_E is the semimajor axis and P_E the orbit period of Earth.

We have to note that in (11) the mass of the Earth can be neglected and this is the reason why this equation cannot be used for the computation of the masses of the other planets.

Therefore, the use of the orbit of a satellite of the planet is preferred.

This way Newton was, able for the first time, to measure and size the universe but, as he suspected, *Nature is confident to herself*, and often hardly reveals its secrets.

If the world were made of terrestrial planets, ***Fo*** and *G* would be almost perfectly constant.

Our atomic gravity clock says that only the mean can be considered constant and really is constant for the majority of nuclides and for mixtures of them.

For the first elements of the periodic table, we have the values reported in **Table 1**, computed with Equation (7) for all known nuclides.

If the Sun and the gaseous giant were 70% H1 and 30% He4 we might have $Fos = Fog = 6.257$ that is 93.834% of ***Fo***.

To maintain the neutrino flux of the Sun, for running the planets, $F = \boldsymbol{Fo} M_s$, the mass of the Sun should be $M_S = M_s/0.93834$ and the same correction would be applied to all gaseous planets.

One may object that the Sun is subject to many nuclear fusion reactions, that produce the radiant heat that we enjoy on our Earth

Its study has involved, for almost sixty years, hundreds of scientists for identifying the reactions involved from the high energy neutrino emissions and from the experimentally measured reactions' cross sections [9].

In his review [9] Bahcall confesses that 99.99% of neutrino flux is low energy and that there is no direct measurement of this spectrum. That is because attention is focused on heat release, neutrino and gravity are considered separate phenomena and on the basic deuterium synthesis kinetics, difficult to be experimentally determined.

We know however that the anergy released, for warming the solar system is small compared with the energy involved with the neutrino flux for maintaining the planets in their orbits.

Table 1. Values of elementary neutrino flux per gram and second *Foi* of light nuclei, compared with the mean value of all nuclides ***Fo*** = 6.668+E20 neutrino per gram and second.

n1	5.747E+20
H1	6.326E+20
H2	6.044E+20
H3	5.958E+20
He3	6.168E+20
He4	6.096E+20
He5	6.025E+20
He6	5.98E+20
He8	5.923E+20

The Sun with a mass $M_S = 1.989E+33$ g or $M_S = 2.1197E+33$, that comes from Newton or from its correction, spends, with the neutrino flux, a tremendous amount of energy to control the merry go round of Earth and of the other planets and to maintain its spherical shape, avoiding spreading of matter in the space under the pressure of fusion reactions. The Sun loses 2.22E+30 g/s with low energy neutrino flux, not considered in all existing Sun models, the neutrino high energy being the minor fraction and only a tool for investigating the nature of nuclear fusion reactions.

The energy produced by fusion reactions that heats our Earth and that we can measure from the surface temperature of 5800 K and has the enormous figure of 3.846×10^{26} W. represents a mass loss of only 1.0678E+14 g/s that is very small, if compared to the neutrino loss, the solar wind of 8E = 11 g/s included.

These observations stimulate us to open additional chapters because we feel that the information, enclosed in this brief note, could change our view on the model and the life of the Sun, of the whole planetary system and of the galaxy.

4. Conclusions

When the causes and the mechanics of a natural phenomenon are known it is easier to proceed for a solution and eventually for further investigations. That is the case of the computation of the solar system, the modelling of the Sun and of the galaxy.

With the universal gravitation equation, Newton had many reasons for being satisfied, but the concept of Gravity as a force and its coupling with the equation of motion, caused many head hakes with the multibody problems.

Einstein correctly shifted toward a field representation but, lacking a physical understanding, he imagined a space-time geometrical representation and covered the whole with heavy mathematical equations that are even nowadays inadequate for the three-body problem, even with the aid of fast numerical machines.

In the absence of other theoretical findings, the attention was therefore devoted to high energy costly experimental facilities, to search the boson of Gravity or to underground look for the neutrino, hoping to capture unconventional solar neutrino or waiting for a celestial catastrophic event, like a supernova explosion within the next hundred years.

The sky is now the preferred lab and there we find new unseen objects like neutron stars and black holes that should have mass and gravity so high that nothing can escape their surface.

Einstein was not favorable to black holes [10] even if derived as a mathematical limit of his theory and forced in the center of the galaxy to justify their peripheric motion.

After this talk on gravity, I myself feel perplex with these invisible bodies, for the discrepancies with this presentation, but I encourage to continue looking the sky, with a Galilean attitude, to demonstrate, with the aid of mathematics, their eventual existence.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Notation

F: Newton attraction force ($g \cdot cm/s^2$)
G: Gauss constant (**6.668E−08** $cm^3 \cdot s^{-2} \cdot g^{-1}$)
g: gravity on Earth (9.8 cm/s^2)
M_1, M_2: masses (g)
M_E, M_S: mass of Earth and Sun (g)
M_S: corrected mas of Sun (g)
m: generic body mass (g)
R: distance (cm)
R_E: radius of Earth (cm)
R_{SE}: distance Earth-Sun
V_E: speed of Earth
λ: wavelength (cm)
μ: neutrino mass (1.55277E−36 g)
υ: neutrino number
Fo: mean neutrino flux (**6.668E+20** $\upsilon/g \cdot s$)
Foi: neutrino flux of single nuclei ($\upsilon/g \cdot s$)
Fos: *Fog* neutrino flux of Sun and gaseous planets ($\upsilon/g \cdot s$)
F: neutrino flux ($\upsilon/cm^2 \cdot s$)
m_n: nucleon mass (g)
r_n: nucleon radius (cm)
c: speed of light (cm/s)
n: neutron
ni: neutrons of nucleus i
p: proton
pi: protons of nucleus i
a: atomic mass (g)
ai atomic mass of nucleus i
no: number of nuclei examined
β^+: positron
β^-: electron
k_1, k_2, k_3: constant in Equation (5)
a_E: semimajor axis of Earth (cm)
P_E: orbit period of Earth (s)