

Notes on the Motion of Celestial Bodies

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Abstract

A novel method for the computation of the motion of multi-body systems is proposed against the traditional one, based on the dynamic exchange of attraction forces or using complex field equations, that hardly face two-body problems. The Newton gravitational model is interpreted as the emission of neutrino/gravitons from celestial bodies that combine to yield a cumulative flux that interacts with single bodies through a momentum balance. The neutrino was first found by Fermi to justify the energy conservation in β decay and, using his model; we found that the emission of neutrino from matter is almost constant independently from the nuclides involved. This flux can be correlated to Gauss constant G, allowing the rebuilding of Newton law on the basis of nuclear data, the neutrino weight and the speed of light. Similarly to nature, we can therefore separate in the calculations the neutrino flux, that represents the gravitational field, is dependent on masses and is not bound to the number of bodies involved, from the motion of each body that, given the field, is independent of the mass of bodies themselves. The conflict between exchanges of forces is avoided, the mathematics is simplified, the computational time is reduced to seconds and the stability of result is guaranteed. The example of computation of the solar system including the Sun and eight planets over a period of one to one hundred years is reported, together with the evolution of the shape of the orbits.

Keywords

Astrophysics, Celestial Mechanics, Nuclear Physics, Particle Physics, Gravity, Grand Unified Theory

1. Introduction

The problem computing the interactive forces of a group of celestial objects and consequently of predicting their orbital motion for all future times has been, after Newton, the headache of scientists and mathematicians till nowadays.

Newton himself solved the problem of two interacting bodies, but he soon discovered that, for multiple bodies, his differential equations of motion did not predict some orbits correctly: the attracting forces do conform to his *laws of motion* and to the *law of universal gravitation*, but the many multiple interactions make any exact solution intractable.

The problem of finding the general solution was considered very important and challenging: in the late 19th century King Oscar of Sweden, established a prize for anyone who could find the solution to the problem, The prize was awarded to Poincaré, even though he did not solve the original problem but a restricted three-body problem in which the third mass is negligible.

The general n-body problem fell in the hand of mathematicians: the elegant Hamilton's approach transforms the original Newtonian system of $3n$ second order differential equations of motion in a system of $6n$ first order differential equations with $3n$ position coordinates and $3n$ momentum values; however no analytical or numerical solution has been found.

After the extensive work of Poincare [1] [2], many proposals and models of Celestial Mechanics, both numerical and analytical or a mixture of the two, are present in the literature, and also full books have been written.

Unfortunately all works are based on the idea of interacting forces, that, after the failure of eminent mathematicians and on the basis of our modest experience, we consider an incorrect representation of gravity.

We did not find in the literature an alternative view as that presented in this paper and therefore, instead of boring the reader with incorrect mathematics and unsuccessful results, we want only to cite the recent opinion of Celletti [3], an expert researcher working in the field, that sounds like a voice outside the crowd.

“An accurate prediction of the dynamics of the objects of the solar system often requires very long computations; even the easiest problem provided by the two-body model deserves computational skill in solving Kepler's equation, which allows deriving the Keplerian elements of the orbit as a function of time.

In passing from the two to the three-body problem, an increasing complexity, due to nonintegrability and chaos, is a trademark of Celestial Mechanics; the three body problem motivated the development of perturbation theories aimed to find approximate solutions of the equations of motion.”

Therefore the fault is not of the Newton model, nor of mathematics, but of the way mathematic is applied.

For those that are interested in the relation between mathematics and physics we suggest the last recent book of Penrose [4] *The Road to Reality*.

The book is just over 1100 pages, of which the first 383 are dedicated to mathematics: Penrose's goal is to acquaint inquisitive readers with the mathematical tools needed to understand nature.

Only on the last page of the conclusion, he wisely invites the reader to open a different window for understanding the unknowns of the Universe.

In the case under study, of celestial mechanics, the escape from the exchange of forces model was found in the so called *field equations* models.

Every engineer expert in fluid dynamics had the opportunity to deal with the Navier-Stokes field equations, that describe the motion of viscous fluids through mass, momentum and energy balance, and is aware of the problems encountered in their use to solve real problems.

Remember that these equations were written applying balances to a cell of fluid and then transforming finite differences to derivatives by the limit to zero procedure.

The analytical solution of these equations is, except for simpler cases, impossible, due to the large nonlinearities, the nature and properties of fluids (forgetting the turbulence tensor) and the boundary conditions that are the cause of instabilities.

The numerical solution involves the opposite procedure of transforming differential equations into finite difference equations, that are usually different from the original elementary cell balances, are numerically less stable and need a convergence with boundary conditions.

The use of parametric functions or series of functions followed by parameters optimization, partially solves the instability problems but is quite approximate.

Therefore, in solving scientific or engineering problems, we decided to maintain the original cell balances, selecting the cell size, the cell equations according to the nature of phenomena involved and including boundary conditions: the resulting system of nonlinear equations can be easily solved by available computer programs [5], almost independently from the problem complexity and size.

The use of computers, not available at the times of Newton and Poncarè, helps in the simplification of mathematical algorithms and computation procedures and, contrarily to the common opinion, to bring researchers nearer to physical phenomena, if supported by experimental data.

It would have been impossible for Maxwell to write his electromagnetic field equations, without the anticipation, the experiments and the investigations of Faraday, a genius with poor formal education and limited knowledge of mathematics.

Maxwell's equations are again partial differential equations that relate the electric and magnetic fields to each other and, in spite of the elegant and exhaustive description of the phenomena involved, they are very difficult to solve due to nonlinearities and boundary conditions.

As far as multiple attractions or repulsion are concerned, the two bodies problem is again a limit for analytical calculations and numerical calculations do not go far ahead.

When Einstein was in trouble with the problem gravitation, the example of Maxwell, whose equations are in line with Lorentz transformation and hence with special relativity, paved the way.

Einstein field equation theory, as explained in [6], are hard to swallow but, after the theoretical presentation of tensor properties, the elegance of mathematics is impressive and the capability of including both fluid dynamics (Navier-Stokes) and electrodynamics (Maxwell) is surprising.

For this reason Einstein field equation was considered, during the last century, a mathematical monument comprehensive of all the laws of the Universe.

However we feel uncomfortable with its use for solving real problems, even with the aid of supercomputers and there is no knowledge of its use for systems exceeding two bodies.

We have also to recognize that the theory is far to be simple, in contradiction with Einstein main thought: “*most of the fundamental ideas of science are essentially simple and may, as a rule, be expressed in a language comprehensible to everyone*”.

The concept of exchange of forces has been overcome by the idea of the curvature of space-time, a sort of mobile mathematical basin built around the bodies that constrains all physical bodies and make them move along specific lines.

In the absence of the knowledge of the nature of gravity we hold this as a sophisticated representation of a phenomenon that Galileo tried to explain to Simplicio making him rotate a physical bucket full of water, in the *Dialogue Concerning the Chief World Systems (Dialogo dei Massimi Sistemi)* [7].

Einstein thought dominated the scene of the last century generating a school of scientists that under his name are proposing new investigations and advance new theories.

My feeling is that we are shortening times and enlarging figures beyond what Nature is telling us.

What follows is an example of joining experimental facts taken from mechanics, nuclear data and quantum mechanics theories, to change our view of the motion of bodies in the sky.

2. The Gravity Field Equation Simple

The number of important laws of physics can be counted on the fingers of one hand and may change with time; the experiments, if properly performed, will step in science forever, ready to be explained and used in different periods of time,

One of these important experiments is that performed by Galileo with the falling of objects of different shapes, weight and size at the same time, due to Earth gravity.

Galileo could not appreciate the secret hidden under his experiment and he spent his life, even when arrested in home, to look at the sky with his telescope; the sky was also the preferred reference of Copernicus, Kepler and Newton for gravitational phenomena.

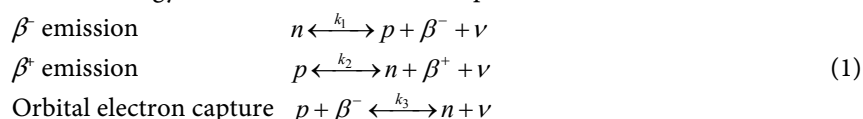
Till nowadays gravitation has been segregated in the sky, but the Galileo experiment suggests another direction that even Einstein could not imagine: if the action of gravity is the same on a ball of iron and on a piece of wood it should

not depend on the chemical and type of nuclide involved but has to relate to the elementary particles, neutrons and protons that are common to all matter.

Therefore, if we want to understand the nature of gravity, our investigation should be moved away from the fantastic objects appearing in the sky and fix our attention on the nuclear structure of matter.

We had to wait four centuries, after Galileo, before Fermi [8] developed a theory of β decay and justified the existence of the neutrino ν , an elusive particle that can cross matter without interaction.

He assumed the following nuclear dynamic transformations of protons p , neutron n and electrons/positrons β^-/β^+ with the neutrino ν compensating for the lack of energy in the electrons emission spectrum:



And the electron-positron annihilation reaction with the production of two γ photons having energy of 0.511 Mev each, equal to the rest energy of an electron,

$$\beta^- + \beta^+ = 2\gamma \quad (2)$$

This scheme also justifies the number of nuclear bonds and the nuclear binding energy of nuclides [9] and, if we argue that this reaction scheme is valid not only for radioactive nuclides but can be extended to all nuclides at all temperatures, we have a model and a new law for the emission of radiation from the bulk of matter.

From Equation (1) we can compute the neutron and proton dynamics in all nuclides [10]:

We assume $k_1 = 0.0009625$, experimentally known, being related to the 12 minutes half life of neutron, and derive the other constants by fitting the neutron/ proton distribution of the 1806 known nuclides including stable nuclei and γ emitters.

The least square fit of the proton and neutron distribution gives the following values with an astonishing determination index equal to 99.7%:

$$k_1 = 0.0009625, \quad k_2 = 4.71554E-06, \quad k_3 = 0.00105382 \quad (3)$$

If we use these constants to compute the rate of neutrino emission, we discover that it is almost constant for all nuclides with a mean value of $F_o = 6.668E+23$ neutrino per kg and per second and this value does not significantly change from light to heavy nuclides as first reported in [10].

We remember that, following Plank, matter emits radiation from the surface independently from its chemical or physical composition (another experimental fact), in agreement with our result based on fitting data of all known nuclides.

The radiation is generated and transferred at various temperatures but we know that the nuclear clock is not affected by temperature and therefore the constancy of atomic matter emissivity is an important new law of physics.

The radiation is generated by nuclei in the bulk of a body, only part of it reaches a small layer near the surface where is emitted in the form of light, with

a Black Body spectrum, the remaining part, the most important one is filtered and degraded by matter and escapes undetected from the body in the form of the elusive neutrino and is the one justifying Galileo experiment and the one responsible for “*moving the Sun and the other Stars*”.

However only a small portion of the neutrino flux interacts with the physical bodies, the majority being dispersed in the space: the neutrino is therefore responsible for the increase of the entropy of the Universe, with the stars losing mass, the attraction between celestial bodies decreasing and the expansion of the Universe continuing slow in our time frame.

Anyhow, once known the position and the mass M_i of celestial bodies, the vector flux of neutrino F_s per unit area in a point of the space at a distance R_i and unit vector r_i can be easily computed by vector summation of bodies flux contributions:

$$F_s = F_o \sum_i M_i r_i / (4\pi R_i^2) (\text{neutrino/m}^2) \quad (4)$$

The neutrino flux is spread on the surface of the sphere of radius R_i but we are interested in the surface available that is the cross section σ_n of nucleon (proton-neutron) having mass m_n (kg) and radius r_n (m):

$$\sigma_n = \pi r_n^2 / m_n (\text{m}^2/\text{kg}) \quad (5)$$

The neutrino crosses matter without interaction and we can define the neutrino flux per unit weight of crossed matter:

$$F_m = \sigma_n F_s (\text{neutrino/kg} \cdot \text{s}) \quad (6)$$

This unit piece of matter itself emits neutrino in all directions that sum with the neutrino field in the positive direction of F_m and subtract in the opposite one, the result being a net emission in the F_m direction,

Neutrino has a mass μ and travel with the speed of light causing a pull opposite to F_m

$$F_g = -\mu c F_m (\text{m/s}^2 \cdot \text{kg}) \quad (7)$$

that is equivalent to Newton attraction force.

The Gauss constant G therefore can be easily related to nuclear parameters:

$$G = F_o \mu c r_n^2 / (4m_n) = 1E + 34F_o = 6.668E - 11 (\text{m}^3 \cdot \text{s}^{-2} \cdot \text{kg}^{-1}) \quad (8)$$

The magic of this relation has no explanation but the relevant point is that we can write G and the Newton Universal Gravitation Equation on the sole basis of nuclear properties,

The other important point is that we can compute the gravitational field in terms of neutrino flux per m^2 or per kg or momentum for whatever complex system of celestial bodies once known their position, their motion being left to a subsequent step.

For the particular case of two dimensions Cartesian coordinates with n celestial bodies having mass M_i and position x_i , the components F_{sx} and F_{sy} of the neutrino flux F_s (4) at the point x, y can be written:

$$\begin{aligned}
 F_{sx} &= F_o \sum_i M_i (x_i - x) / (4\pi R_i^3) \\
 F_{sy} &= F_o \sum_i M_i (y_i - y) / (4\pi R_i^3)
 \end{aligned}
 \tag{9}$$

where $R_i = \sqrt{(x_i - x)^2 + (y_i - y)^2}$ and the module of the flux F_s being $F_s = \sqrt{F_{sx}^2 + F_{sy}^2}$.

Similar relations can be written for F_m and for F_g .

Here we use, as example, a simplified solar system with the Sun and only the eight planets, with the data, taken from literature, reported in **Table 1**.

To make it simpler we start with the origin in the Sun and with the planets positioned along the x axis at the given distance from the Sun.

For the representation the original scale of values has been maintained in spite of the large distances and the high values of the module F_s .

The values of neutrino flux are based on the mass, diameter and aphelion distance from the Sun of Tab. 1 and are plotted on a 100×100 Excel spreadsheet for detailed views of parts of the solar system.

The neutrino flux F_s (neutrino/m²) can be easily computed for the simple case of the main planets of the solar system but we could equally consider whatever additional body rotating with them around the Sun.

Figure 1 shows the module of the neutrino flux F_s , that is the is flux lines, in the zone of the terrestrial planets, all other planets being present, while **Figure 2** reports a view of the gaseous planets zone.

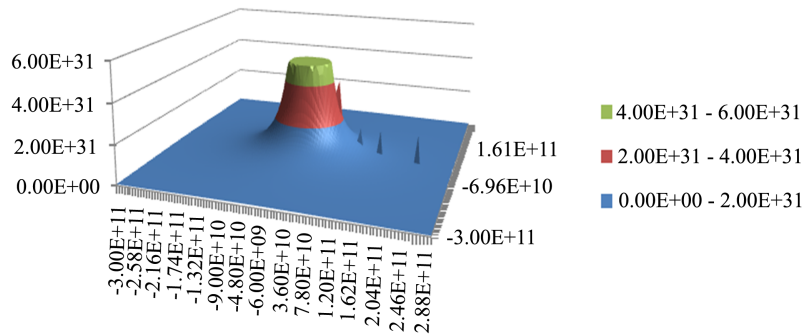


Figure 1. Map of neutrino flux F_s , truncated near the Sun, for the four terrestrial planets (evidenced by a cusps).

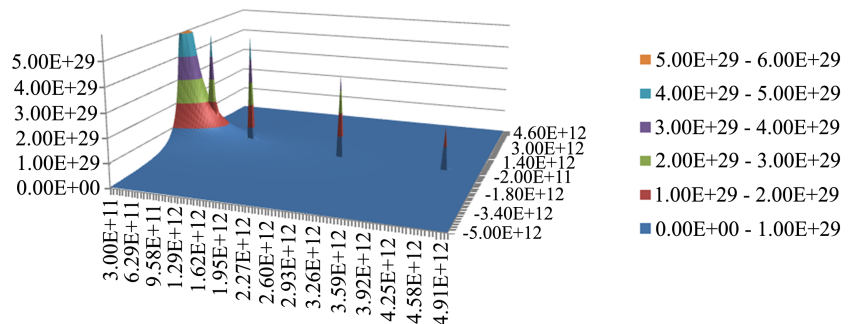


Figure 2. Map of neutrino flux F_s around the Sun for the four gaseous planets (evidenced by a cusps).

Table 1. Data of sun and planets used in the calculations.

	SUN	MERCURY	VENUS	EARTH	MARS	JUPITER	SATURN	URANUS	NEPTUN
MASSkg	1.990E+30	3.3300000E+23	4.869000E+24	5.972190E+24	6.4191000E+23	1.898700E+27	5.651000E+26	8.684900E+25	1.024400E+26
DIAMETER m	6.960E+08	2.4396400E+06	6.051590E+06	6.378150E+06	3.39700000E+06	7.149268E+07	6.026714E+07	2.555725E+07	2.476636E+07
ECCENTRICITY	0.000E+00	2.0560000E-02	6.800000E-04	1.670000E-03	9.34000000E-03	4.840000E-03	5.410000E-03	4.720000E-03	8.600000E-04
Semimajor axis m	0.000E+00	5.791000E+10	1.082100E+11	1.496000E+11	2.27920000E+11	7.785700E+11	1.433530E+12	2.872460E+12	4.495060E+12
MEAN DISTANCE m	0.000E+00	5.790917E+10	1.082089E+11	1.495983E+11	2.27956600E+11	7.784120E+11	1.426725E+12	2.870972E+12	4.498253E+12
APHELIUMm	0.000E+00	5.910063E+10	1.082836E+11	1.498498E+11	2.30048800E+11	7.823382E+11	1.441285E+12	2.886018E+12	4.498926E+12
$\eta(v_i \text{ correction})$	0.04	0.17	0.11	0.06	0.04	0.04	0.04	0.04	0.04

Figure 3 is a snapshot of Jupiter where the prevailing values of Jupiter emission are evidenced together with the subtraction of neutrino flux in the direction of the Sun and the sum up in the opposite direction.

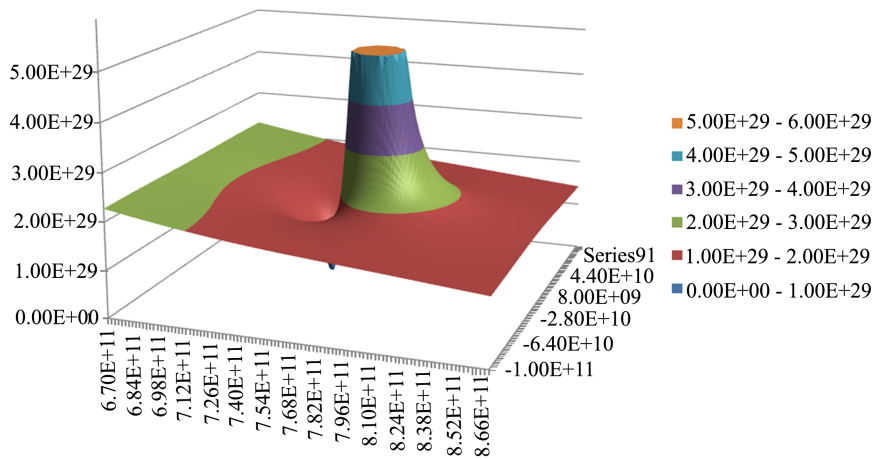


Figure 3. Map of neutrino flux F_s around the Jupiter (evidenced by a truncated cusps).

Everybody can appreciate how easily and comfortably this calculation can be done without the anxiety of mutual interactive competing forces.

The neutrino flux is therefore the real field equation for proceeding to celestial mechanics calculations: the cause of motion is a physical reality, separated from the effect, the motion itself.

Therefore Newton law should not be interpreted as an exchange of forces but as the emission by bodies of neutrino in the space that causes a neutrino unbalance on the receiving bodies.

Newton law is still valid, the mathematics is formally the same but the use of equations is different: cause and effect are separated.

3. Fast and Stable Planetary Orbit Calculation

Now that we have a precise and simple representation of the gravitational field, an object, immersed in this field, is willing to move and we know that our planets move following a quasi-circular orbit or better an elliptic orbit around the

Sun.

Due to planets motion, the Sun also moves together with them around a barycenter whose coordinates are:

$$\begin{aligned}x_b &= \sum_i x_i M_i / \sum_i M_i \\y_b &= \sum_i y_i M_i / \sum_i M_i\end{aligned}\quad (10)$$

The velocity and acceleration of all orbiting bodies are better defined using polar coordinates (r, ϑ)

$$\text{velocity} = v_r \mathbf{r} + v_\vartheta \mathbf{g} \quad (11)$$

$$\text{acceleration} = a_r \mathbf{r} + a_\vartheta \mathbf{g} \quad (12)$$

where \mathbf{r} and \mathbf{g} are the radial and tangential versors.

The coefficient of radial acceleration, following Newton, is equal to F_g and that of the tangential acceleration is zero and is related to the momentum conservation:

$$a_r = r'' - r\vartheta'^2 = r'' - v_\vartheta^2/r = -F_g \quad (13)$$

For a circular orbit the second derivative of r , r'' is equal zero, $a_\vartheta = -v_\vartheta^2/r$ and the velocity v_ϑ can be directly computed from F_g :

$$v_\vartheta = \sqrt{rF_g} \quad (14)$$

Equation (14) can be used for a first local approximation but if we insist for a Keplerian orbit we can use the Vis-viva equation [11], derived from the conservation of energy and momentum, that we can rewrite in the following form:

$$v_\vartheta = \sqrt{F_g r (2 - r/a)} = \sqrt{rF_g - rF_g (r/a - 1)} \quad (15)$$

from Equations (13) and (15) we can compute the second derivative of r , that is related to a property of the ellipse, the semi-major axis a :

$$r'' = F_g (r/a - 1) \quad (16)$$

The gravitational field F_g can be rigorously computed, once known the position of masses M_i while Equations (14) and (15) contain hypothesis about the orbit, are useful locally for the calculation, but the final orbit shape is mainly influenced by the change of F_g from time to time.

The only additional variable we need is the radial velocity v_r in Equation (12), that is zero for circular orbits and is proportional to v_ϑ for the elliptical ones, depending on the eccentricity e , that, like the semimajor axis, should be a result of the calculation.

Therefore we assume

$$v_r = \eta v_\vartheta \quad (17)$$

and find the value of η for the planets imposing the closure of the orbit after the first annual cycles.

The last line of **Table 1** shows the values of η used for the calculations.

The vector \mathbf{v}_r is directed along the radius r toward the barycenter b and using

Equation (17)

$$\begin{aligned} v_{rx} &= v_r (x_b - x) / r \\ v_{ry} &= v_r (y_b - y) / r \end{aligned} \tag{18}$$

The vector \mathbf{v}_g is perpendicular to \mathbf{F}_g and thus using Equations (14) or (15)

$$\begin{aligned} v_{gx} &= -v_g \frac{F_{gy}}{F_g} \\ v_{gy} &= v_g \frac{F_{gx}}{F_g} \end{aligned} \tag{19}$$

and the velocity of each celestial bodies is simply defined by:

$$\begin{aligned} v_x &= v_{gx} + v_{rx} \\ v_y &= v_{gy} + v_{ry} \end{aligned} \tag{20}$$

The problem of the orbit calculation is now reduced to elementary algebra through the following simple steps:

- 1) Given planets positions, compute the barycenter using (10).
- 2) Compute the fluxes $F_s (F_{sx}, F_{sy})$ and $F_g (F_{gx}, F_{gy})$ from (9) at the coordinates of each body.
- 3) Compute the velocity $\mathbf{v} (v_x, v_y)$ of each planet from (20).
- 4) Select a time step dt (1 or two days) and update planet position

$$\begin{aligned} x &= x + v_x dt \\ y &= y + v_y dt \end{aligned} \tag{21}$$

- 5) Return to point 1, with the updated planet position, till the maximum time (1 year, 100 years or more) is elapsed.

Some trial runs can be used to adjust η in Equation (17).

Note that steps 1 and 2 are rigorous and there is no conflict between bodies.

Step 3 and 4 are independent of the mass of the bodies that has been accounted in step 1 and 2 and therefore no conflict is present here too.

Consequently the computation is very accurate and stable with a computer time that can be measured in seconds for processing the elementary algebra (21), most of the time being dedicated to printing results.

Figures 4(a)-(d) show, in the original fixed x, y plane, the orbits, for the first Earth year, of the barycenter, the Sun and the planets.

The calculation has been made using locally the circular orbit approximation that is maintaining the second radial derivative equal zero and computing v_g with Equation (14), but introducing the correction factors η of v_r of **Table 1**.

The orbits are very clean: almost one revolution and one line for the majority of planets and shape apparently indistinguishable from a circle.

If we introduce the second derivative in Equation (15) and maintain the same correction factor for v_r the results appear very similar, the controlling factor being the field equation \mathbf{F}_s (4) representing the flux or momentum \mathbf{F}_g (7) of neutrino.

We report for comparison in **Figure 5** the terrestrial planets orbits using Equation (15) for the computation of v_g .

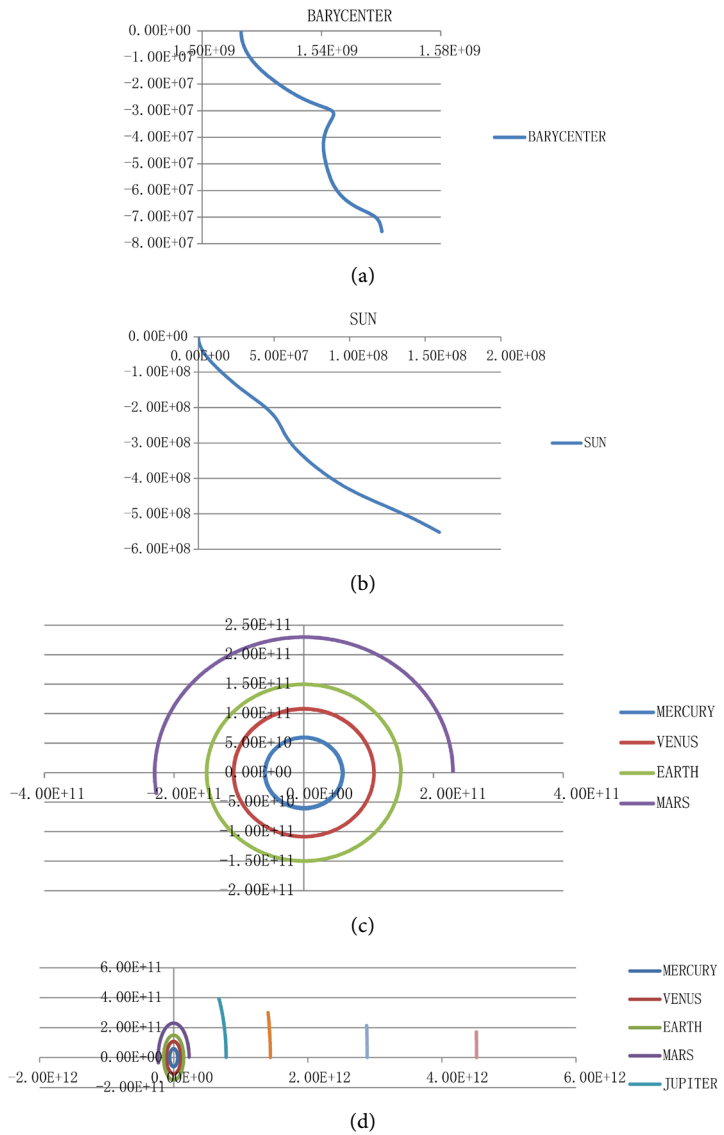


Figure 4. (a) Barycenter trajectory during the first Earth year from the origin of calculations (14); (b) Sun trajectory during the first Earth year from the origin of calculations (14); (c) Terrestrial planets orbits during the first Earth year from the origin of calculations (14); (d) Terrestrial and Gaseous planets orbits during the first Earth year from the origin of calculations (14).

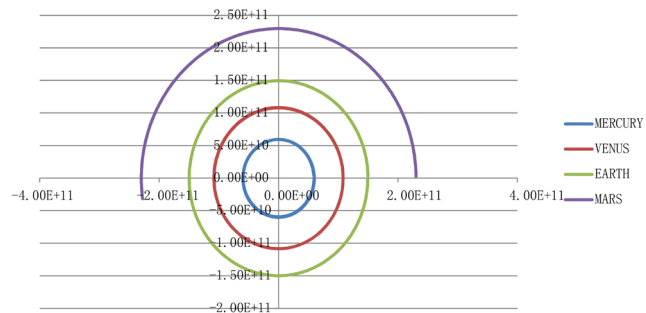


Figure 5. Terrestrial planets orbits during the first Earth year from the origin of calculation (15).

The orbits of **Figure 5** are very similar to those of **Figure 4(c)** as if the gravitational field is prevailing over the tricks of the calculation.

Changing the integration step from one to two days has no effect and the computation time is almost instantaneous.

The computation over an extended time of one hundred Earth years is equivalently stable allowing many rounds of the terrestrial planets and some complete run of the gaseous ones; the computational time again is less than ten seconds.

The calculation has been made with a time step of 1.2 days exceedingly small for the phenomena involved and in agreement with the graphical ability of Excel.

Figures 6(a)-(d) show the motion of the Barycenter and the Sun and the orbits for the terrestrial and gaseous planets using Equation (14) for v_θ and the η correction for v_r of **Table 1**.

In **Figure 6(a)** one can distinguish the effect, on the motion of barycenter, of the rapid rotation of the terrestrial planets and the slow motion of the gaseous ones,

In **Figure 6(b)** one can appreciate the slow motion of the pachyderm Sun to compensate the planets merry go-round.

In **Figure 6(c)** the orbits of the terrestrial planets appear to shift revolution by revolution, as if each planet is trying to find the right position compatible with the position of the other planets.

We have selected some orbits within the bunch and they appear identical at the beginning, in the center and at the end of calculations and they appear identical but shifted in space (not reported here).

The orbits of the gaseous planets appear regular, even if they had not enough time to stabilize themselves and to balance the entire solar system.

Figures 7(a)-(d) present the equivalent orbits obtained using v_θ local of Equation (15).

There is no way, even superimposing figures, to distinguish about the results and again it is clear that the dominating force is the neutrino flux F_g in spite of the tricks used to force the Keplerian elliptic orbits.

To better understand the evolution of the orbits we computed, as probably Kepler did, the distance of the planets from the Sun in function of time.

We discover that the time necessary for a planet to settle in stable orbits and find its place in the sky, depends on their frequency and is less for Mercury than for Mars, and that the orbits, appearing circles, are really elliptic.

Figure 8 shows that Mercury rapidly reaches a steady state distance and **Figure 9** gives a gross variation of the distance in a large period of time.

Going to details **Figure 10** shows the variation of distance from the Sun within each Mercury year in a sinusoidal behavior typical of elliptic orbits.

Figures 11-13 show the equivalent oscillations of distances from the Sun for Venus, Earth and Mars.

Mars with its long period of revolution, almost double that of Earth, needs

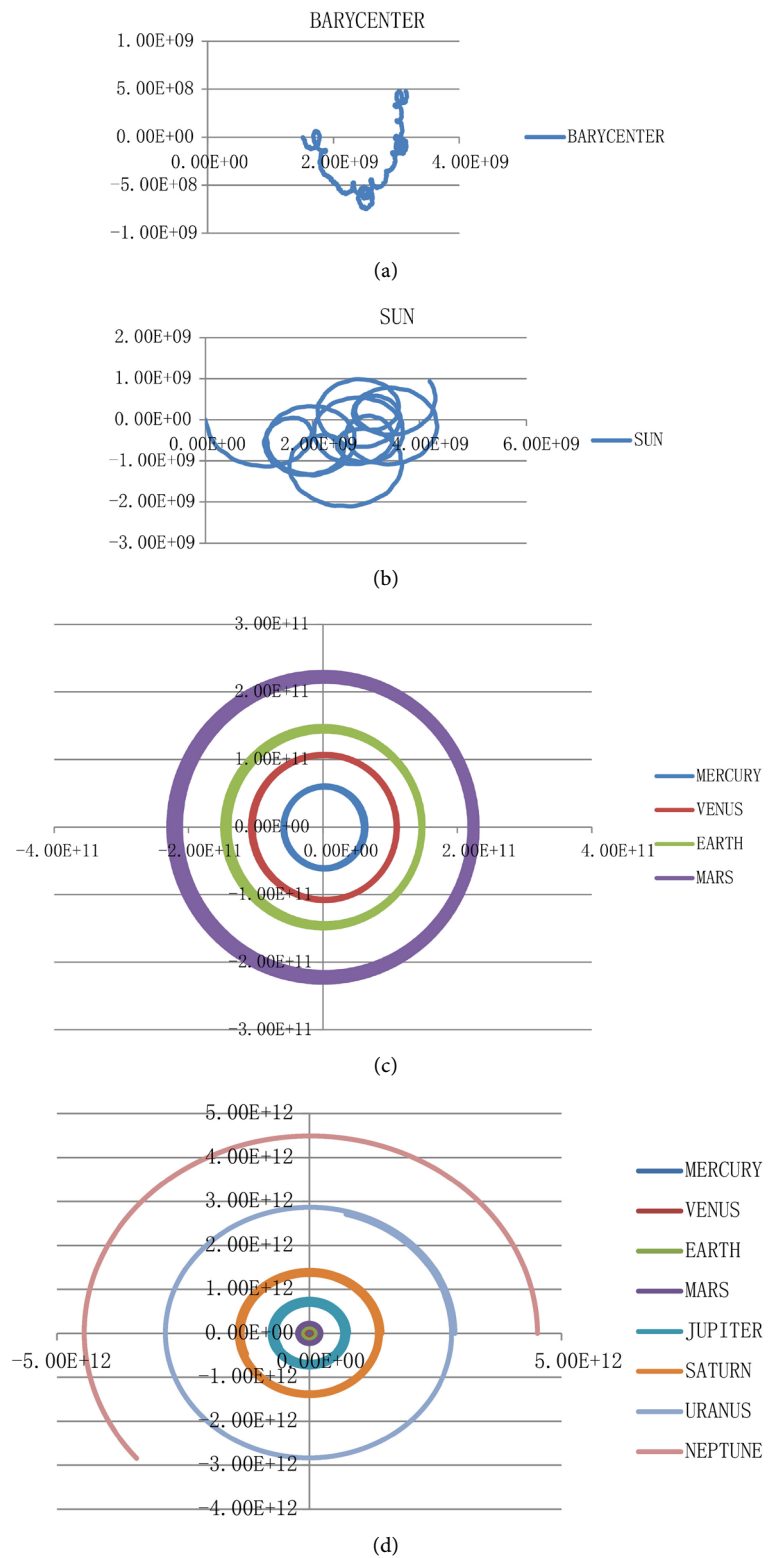


Figure 6. (a) Barycenter trajectory during the 100 Earth years from the origin of calculations (14); (b) Sun trajectory during 100 years Earth years from the origin of calculations (14); (c) Terrestrial planets orbits during 100 Earth years from the origin of calculations (14); (d) Gaseous planets orbits during 100 Earth years from the origin of calculations (14).

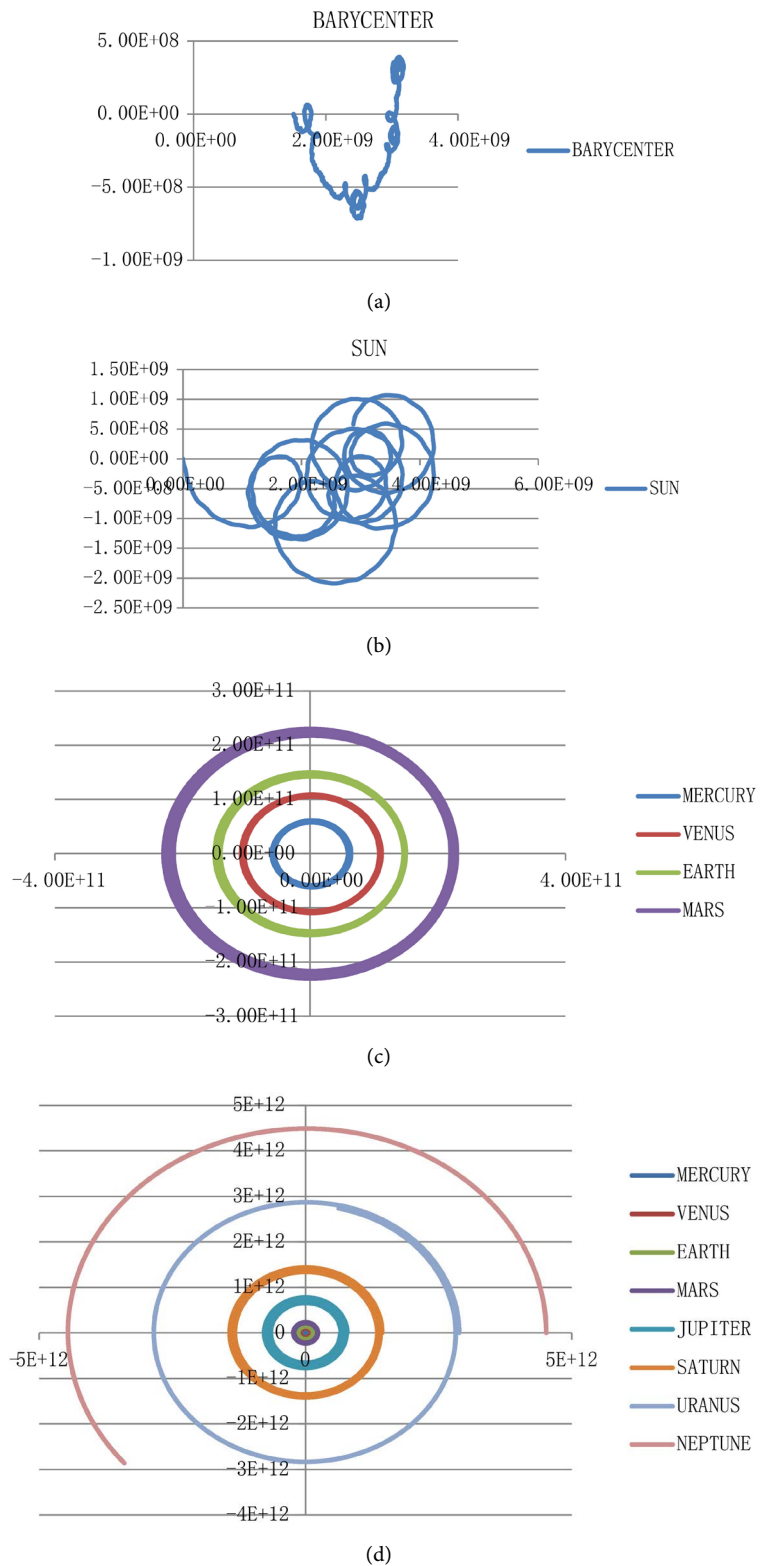


Figure 7. (a) Barycenter trajectory during the 100 Earth years from the origin of calculations (15); (b) Sun trajectory during 100 years Earth years from the origin of calculations (15); (c) Terrestrial planets orbits during 100 Earth years from the origin of calculations (15); (d) Gaseous planets orbits during 100 Earth years from the origin of calculations (15).

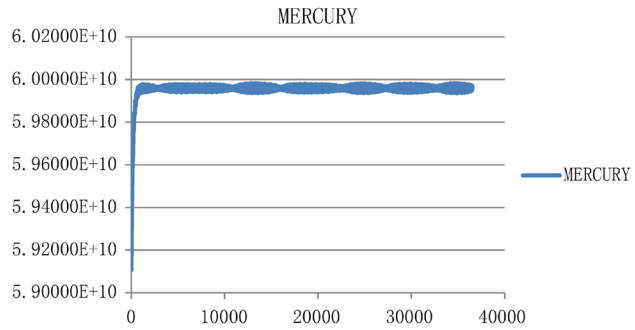


Figure 8. Distance (m) of Mercury from the sun in function of time (year).

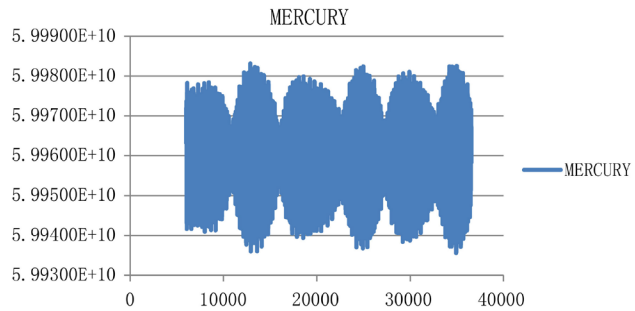


Figure 9. Distance (m) of Mercury from the sun in a large time interval (year).

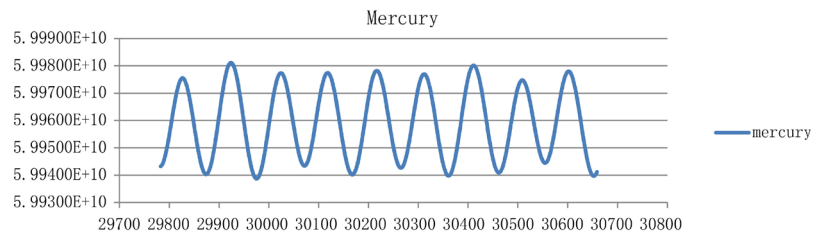


Figure 10. Variation of distance from the sun in a series of Mercury years.

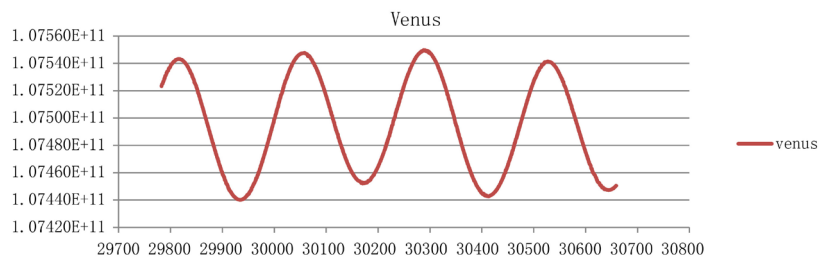


Figure 11. Variation of distance from the sun in a series of Venus years.

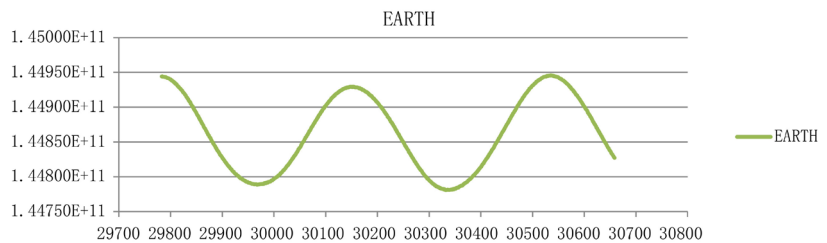


Figure 12. Variation of distance from the Sun in a series of Earth years.

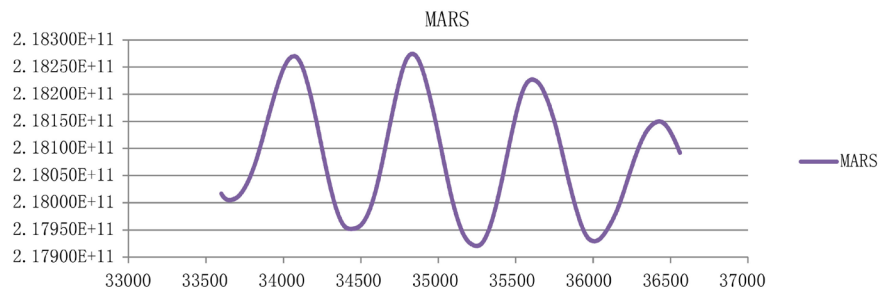


Figure 13. Variation of distance from the Sun in a series of Mars years.

additional time to reach a stable position and still shows an elliptic shape for its orbit.

For the gaseous planets the time needed for stabilization will be longer, but this should not be a problem for our calculation method.

The method presented virtually has no limits in stability and computational time and can be used for studying different starting points, adding additional celestial bodies within or outside the solar system and simulating the evolution over millennia of known clusters of rotating bodies.

We have given only a flavor of what can be done with this tool for analyzing the celestial motion in detail and of the quantity of data available under the simple graphical representation.

We have also shown the merits of this new approach to gravity for multiple celestial bodies calculations.

The comparison with experimental data will be of help both for refining the method and for acquiring a quantitative picture of small and large pieces of the Universe.

4. Conclusions

Gravity has always been seen as an exchange of forces, between massive bodies, that decreases with the square of the distance coherently with Newton Universal Gravitational Law.

The transmission of this force is considered by Newton instantaneous but, due to the large astronomical distance and assuming that the action of this forces propagates with the velocity of light, the interval between the start and the arrival of this force might appear relevant, requiring the introduction of relativistic time in gravitational phenomena.

However if gravity is the result of a flux of neutrino, continuously irradiated from a massive body to a point in the space, this flux is almost the same over a large period of time and the map of these fluxes becomes a quiet and steady valley, where the bodies present receive their impulse to move.

The two approaches give a similar result and have similar mathematics only in the two body case but diverge beyond, with a net distinction between cause and effect, as in the proposed application.

The flux of neutrino (or graviton) is the **cause**, generated by physical bodies,

and can be easily computed summing up all contributions; the **effect**, for a tiny or large object immersed in this flux, is motion.

The flux field can be computed rigorously independently of the number and size of bodies, while motion calculation is independent of bodies' masses.

Natural evolution of phenomena and the calculation have a similar behavior: they are never nervous and unstable, as shown in the stepwise integrations of the planets' orbits, where the result does not change if the time step is one or two Earth days.

As a general rule, derived by the experience on many other applications, we can say that, if a model or a set of mathematical expressions do not fit with physical phenomena, either mathematics are wrong or incorrectly applied.

Therefore we feel comfortable with Newton Law, living on our Earth, and should be also comfortable, travelling in the near and far space, provided we understand and use gravity the right way.

Conflicts of Interest

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

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Nomenclature

p	proton
n	neutron
ν	neutrino
β^-	electron
β^+	positron
γ	photon
m_n	neutron mass (1.67548E-27 kg)
r_n	neutron radius (1.05247E-15 m)
σ_n	neutron cross section (m ² /kg)
μ	neutrino mass (2.02E-39 kg)
c	speed of light (299,730,000 m/s)
η	ratio of v_r/v_θ
G	Gauss constant
k_1, k_2, k_3	nuclear reaction constants
F_o	Neutrino emission per kg of matter per second (6.668E+23 neutrino/kg s)
M_i	Mass of i -th celestial body (kg)
R_i	distance a point of space from i -th celestial body
\underline{r}_i	versor of distance R_i in the direction of a point in the space
F_s	vector flux of neutrino per square meter in a point in the space (Neutrino/m ² s)
F_s	module of \mathbf{F}_s
F_{sx}, F_{sy}	components, of \mathbf{F}_s in the x, y coordinates
F_m	vector neutrino flux per kg of matter (neutrino/kg s)
F_g	vector neutrino momentum flux per kg of matter (cm/s ² kg)
F_g	module of \mathbf{F}_g
x_p, y_i	coordinates of i -th orbiting body
x_b, y_b	coordinates of barycenter of orbiting bodies
r	versor radius of orbiting body in barycentric angular coordinates
r	radius
r''	second derivative of r
ϑ	versor angular position of orbiting body in barycentric angular coordinates
a	semi major axis
e	eccentricity
v_r, v_θ	radial and angular velocity
v_{rx}, v_{ry} and $v_{\theta x}, v_{\theta y}$	cartesian components of v_r, v_θ
a_r, a_θ	radial and angular acceleration