Gravitational model of the three elements theory

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The gravitation model of the three elements theory gives explanations for the dark matter mysteries, and the Pioneer anomaly. Concerning the earth flyby anomalies, the theoretical order of magnitude is the same as the experimental one. A very small change of the perihelion advance of the planet orbits is calculated by this model. The disparity of the gravitational constant measurements might also be explained. Meanwhile, this gravitational model is perfectly compatible with restricted and general relativity, and is part of the three element theory, a unifying theory.

1. Introduction

The three elements theory is a unifying theory described in [10]. The gravitational model of the three elements theory is based on this theory. This model is made of indivisible particles, or let's say "elements", called "luminous points". Those luminous points travels in space constantly with a speed equal to c, the speed of light. This is detailed in [7]. Let's remind that, from construction, this model is completely compatible with general and special relativity. The study of this article is to describe some results of this gravitational model:

- dark matter mysteries,
- Pioneer anomaly,
- Saturn flyby by Pioneer 11,
- earth flyby anomalies,
- perihelion advance or precession of Mercury and Saturn,
- disparity of the gravitational constant measurements.

This article can be seen as a summary of [9]. Therefore, for more informations, the reader is invited to read [9].

2. The gravitational model

This model is thoroughly explained in [7]. Let's summarize it. It is based on the inner mechanisms of restricted and general relativity. Each of the Lorentz transformation details, space-time deformation by energy, following geodesics, and strong equivalence principles has been used in order to construct this gravitational model.

Moreover, the attempt is to explain Lorentz transformations with the help of those general relativity principles. During this attempt, some inconsistencies are found. The resolution of these errors lead to stating that matter is composed of indivisible particles, called "luminous points". Those "points" are always travelling in space at the speed of light. They generates around them a radical space-time deformation. These deformations are propagated at the speed of light in every space directions, and are combined together with the help of a non-associative and non-linear operator, called the "relativistic operator". This operator is only applied once, at any point of space and at any time. Therefore, the shape of space-time at any space-time point is determined by the propagated space-time deformations coming from the luminous points in the universe, along the relativistic cone centered on this point. Therefore, the local gravitation law depends strongly on the energy distribution among the universe.

By construction, this mechanism retrieves Lorentz transformation details. But moreover, it allows to retrieve Newton's law for long distances and for a constant and homogeneous distribution of energy in the universe. The key point is that this Newton's law is only retrieved for long distances, and for this special energy distribution. For short and intermediate distances, Newton's law is no longer retrieved. That's what is called "first modification of Newton's law". And for a non constant distribution of energy, the Newton's law is even more modified. This one is called the "second modification of Newton's law".

3. Dark matter mysteries

Applying this "second modification of Newton's law" to the case of galaxy matter distributions leads to a direct explanation of the anomalous speed profile of the galaxies. Indeed, the theoretical curve is close to the measured one. The figure 1 shows the NGC 3310 speed profiles.

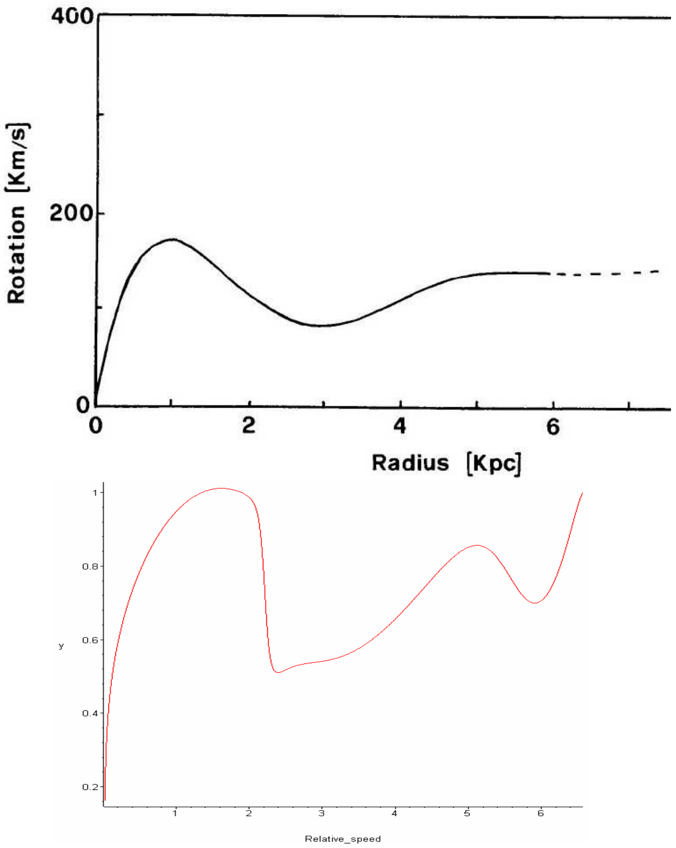

Figure 1: Comparison of the speed profiles for the NGC 3310 galaxy. Above is represented the measured curve, extracted from [6], and below the theoretical one. For the 2 curves, x-coordinate is in kpc. Y-coordinate is in km/s for the measured curve, and with no dimension for the relative speed value of the theoretical curve.

There is an issue of sign for those theoretical speed profiles. Globally, the theoretical speed profiles are well retrieved. But locally, the shape of the curve is not retrieved, but another one, which is exactly the same as the measured one, except that it is reversed along the y-coordinate. Hence, using locally an opposite sign for the equation of the gravitational force, the measured curve is retrieved locally. A plausible explanation of this error is an occultation mechanism during the propagation of the space-time deformations coming from the galaxy luminous points. In this mechanism, the galaxy dust is acting like a fog, occulting partially the space-time deformation propagations coming from the matter located beyond it.
Moreover, the theoretical speed values are retrieved with 17% and 64% of precision, respectively for NGC 3310 and NGC 1068 galaxies. Let's note that those values are interesting only for their order of magnitude, because of the opposite sign issue.
Concerning the mystery of the velocity of a galaxy inside its group, the explanation is more direct. For this mystery, the study calculates a greater value for G, the gravitational constant. Indeed, as soon as the local space-time deformations relies strongly on the surrounding matter densities, the gravitation force is completely different between those two cases: inside a galaxy, and outside any galaxy. The model is even calculating G as a direct function of the surrounding distribution of luminous points in the universe and along the relativity cone:

$$G = \frac{c^4}{\left(\sum_p \sqrt{\frac{8\,e_p}{x_p}}\right)^2} \qquad (1)$$

In this equation (1), c stands for the speed of light, and e_p stands for the energy of a luminous point. The sum is done for each luminous point along an infinitely small space solid angle centered on a point in space where we want to calculate G.

4. The Pioneer anomaly

The Pioneer anomaly is explained in [1]. For this issue, the "first modification of Newton's law" is enough to retrieve a theoretical anomaly value equal to $A_t = 7{,}25\ 10^{-10}$ m/s² , in place of the measured value $A_m = 8{,}74\ 10^{-10}$ m/s² .
But the shape of the theoretical curve is not perfect. The figure 2 shows this theoretical curve.

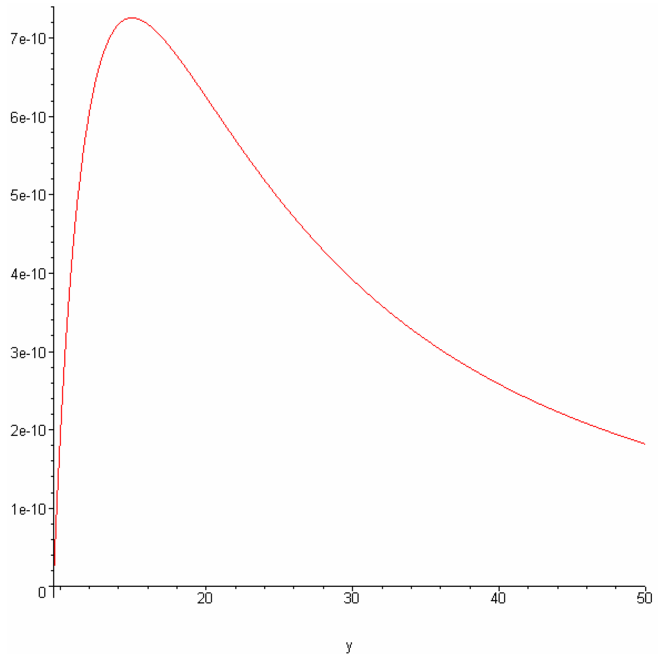

Figure 2: Theoretical curve of the Pioneer anomaly, using the "first modification of Newton's law". x-coordinate is in AU, and y-coordinate is in m/s². Attention, the "0" on the left down corner corresponds in fact to 10 AU.

In order to retrieve the perfect curve, the "second modification of Newton's law" must be used also, taking in account the Kuiper's belt in the distribution of matter of the solar system, rather than the constant uniform distribution of matter (for the first modification of Newton's law). The Kuiper's belt is a belt of asteroids located beyond the location of Saturn, along the ecliptic plane.

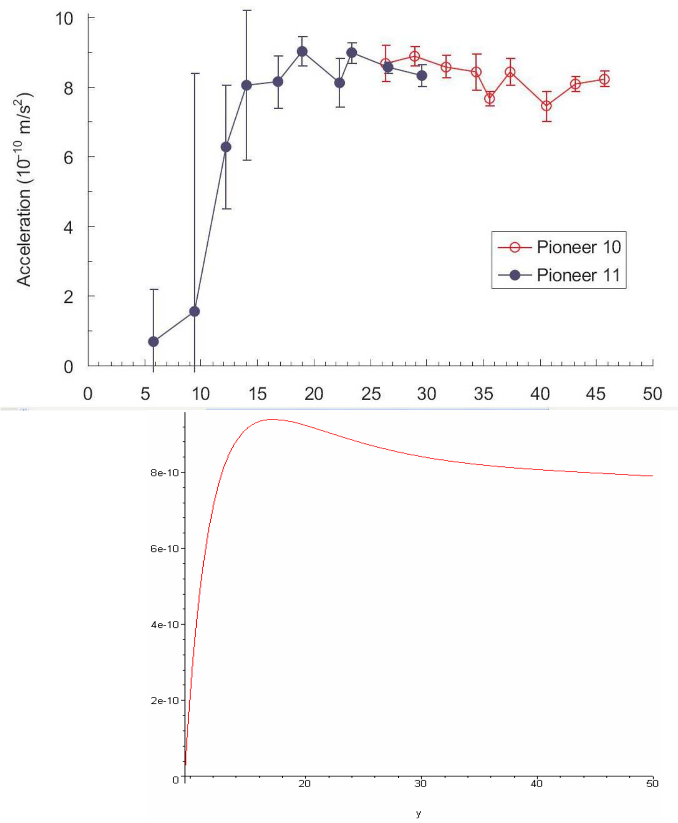

Figure 3: Comparison of the Pioneer anomaly curves. Above is represented the measured curve, extracted from [1], and below is represented the theoretical one, calculated using the "first and second modifications of Newton's law". For the 2 curves, x-coordinate is in AU, and y-coordinate is in m/s². The represented theoretical anomaly is equal to the three elements theory theoretical acceleration toward the sun, minus the theoretical Newton acceleration toward the sun.

Now the result, on figure 3, is very encouraging. On this theoretical curve, the maximum value is exactly equal to

$A_t = 8{,}74\ 10^{-10}$ m/s², which is the exact measured value. But this theoretical curve has been obtain with fitted values for the Kuiper's belt space-time deformations contributions. On the contrary, the curve of figure 2 has been calculated without any fitting.

5. The Pioneer 11 flyby of Saturn

When applying this gravitational model to the case of Pioneer 11 trajectory, an added anomaly is found. It is an acceleration anomaly during the flyby of Saturn. The model is calculating an anomalous decrease before the Saturn encounter, and a anomalous increase after the encounter. The figure 4 shows it.

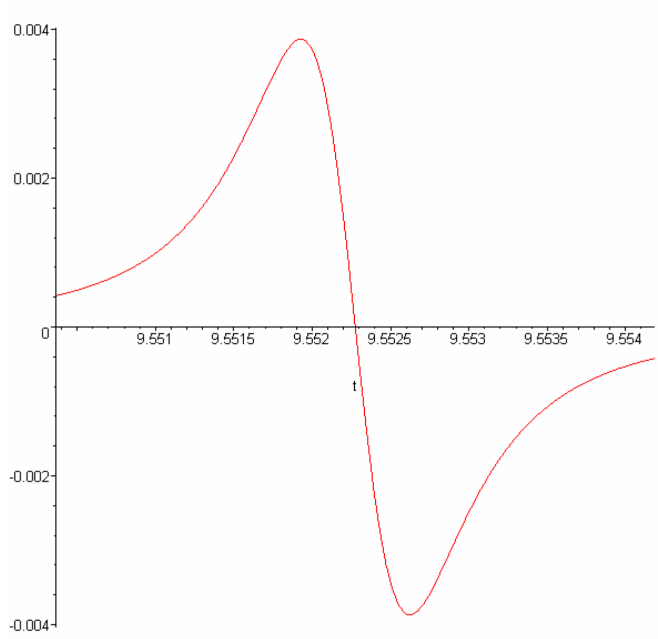

Figure 4: Theoretical curve of the Pioneer 11 anomaly, in the vicinity of Saturn. The calculation is done using the "first and second modifications of Newton's law". X-coordinate is in AU, and y-coordinate is in m/s². The represented anomaly is the sum of the Pioneer anomaly and the Saturn flyby anomaly. The same units as for figure 3 has been used for x and y-coordinates.

On figure 4, an important parameter has been fitted. It is x_{0s}, the distance at which the Saturn gravitational constant, $G\,M_s$, is perfect (M_s stands for Saturn mass).

Indeed, in this gravitational model, those distances are always of great importance: the distances from the attracted masses, where Newton's law is perfect.

The values of figure 4 are very strong, as compared to the Pioneer anomaly values, but the distances range of this anomaly is very short. This range is roughly [9,550 AU, 9.555 AU].

It has been checked that the global Pioneer anomaly curve is still correct for this Pioneer 11 travel, after taking in account this Saturn flyby anomaly. In fact, this global curve shape depends strongly on the x_{0s} value.

6. Earth flyby anomalies

The issue of the flyby anomalies is explained in [5]. When applying the "first modification of Newton's law", the order of magnitude is well retrieved for these anomalies. Table 5 is showing the theoretical added velocity, which is of the same order of magnitude as the measured one.

Probe	Measured anomaly	Theoretical anomaly
Galilleo I	2,56	2,53
Galilleo II	- 2	-11
NEAR	7,21	- 6,6
Cassini	- 1,7	4,5
Rosetta I	0,67	22
Messenger	0,008	29

Table 5: Comparison between the real and the theoretical earth flyby anomalies for 6 probes. The values represents added perigee velocities. Units are in mm/s.

However, those calculations are much too simpler, because they suppose that the earth referential frame is inertial. Of course, this is not true. The calculations must be done at least in the Schwarzchild metric of the sun, and using the motion of the earth, the exact trajectory of the probe, and the contributions of the surrounding matter (asteroids, planets, etc …).
Moreover, the "second modification of Newton's law must be used also, as the Pioneer anomaly analysis shows. Noticeably, the location of the ecliptic plane as compared to the exact probes trajectories, has an important effect on the final result. Indeed, the Kuiper's belt is located on this plane, and the Kuiper's belt influence has been proven in the Pioneer anomaly analysis above. This remark might explain the experimental constatation of the importance of the location of the equator plane as compared to the probes trajectories. Indeed, the equator and the ecliptic planes are not far away from each other.

7. Perihelion advance

When applying the "first correction of Newton's law" to the perihelion advance of Mercury and Saturn, the results of table 6 are retrieved.

Planet	GR value	3elt value
Mercury	42,7848	GRvalue - 0,0014
Saturn	1,66291	GRvalue + 0,00056

Table 6: Modification of the perihelion advance or precession by the three elements theory. On the left are the general relativity results calculated with a computer program. On the right are the added value from these general relativity values. Units are arc-second by century.

The theoretical values are very close from the general relativity values. They do not explain the anomaly of the precession of the Saturn perihelion explained in [2], which is of -0.006 arc-second by century.
But, since the calculated values are very close from the GR values, we can conclude that the three elements theory seems to be compatible here with gravitation experimental measurements.
Moreover, as well as for earth flyby anomalies, the "second modification of Newton's law" must be conducted, in order to check if the Saturn anomaly of [2] is theoretically explained.

8. Measurements of G

The issue is well defined. For nearly three centuries, G has been measured, without getting globally a better precision than 0,7%.
The reason of this globally poor precision is the fact that many measurements values are contradicting each others, taking into account their precision interval.
The first modification of Newton's law is not able to explain this issue. Indeed, the order of magnitude of the theoretical error is far below the experimental one.
But the "second modification of Newton's law" retrieves the same order of magnitude as the measured one. Let's try a simple calculation for estimation.
The ratio below is the relative difference between two values of G, G1m, and G2m. G1m is the measured value of G in [3], when G2m is the measured value in [4].

$$\frac{G_{1m} - G_{2m}}{G_{1m}} = 6,5\ 10^{-3} \qquad (2)$$

Let us assume that those two experiments has been done in completely different places. And the important difference between them is the distribution of matter in the surrounding neighbourhood.

- experiment 1) of [3], for example, is done at the very top of a hill on the floor of a desert, and this floor is completely plane outside the hill on which we are located.

- experiment 2) of [4], is done in the middle of a valley which is surrounded by mountains.

The interesting thing is that the measured value of G will be completely different between those two cases even if exactly the same experiment apparatus and measurement procedure is applied. Indeed, the presence of the surrounding mountains in the second measurement has an important effect on the final measured value.
Let's remind some equations coming from [7]:

$$e1 = \frac{Lu\sqrt{\frac{8R}{x}}}{Lu} = \sqrt{\frac{8R}{x}} \qquad (3)$$

$$e2 = \frac{Lu\sqrt{\frac{8R}{x}}}{Lu + Ls} \qquad (4)$$

Where Lu stands for the result of the symmetric contributions in the case of experiment 1). Those contributions are those of the stratosphere, the solar system, the galaxy, and the extra-galactic objects.
Ls is the added contribution in the case of experiment 2), which is coming from the nearby mountains.
For the two cases, we still get the following equations, coming from [7], with e being e1 or e2, depending of the experiment:

$$\cos(\alpha) = oper(L1, L2) = \frac{\sqrt{1+e}}{1+\frac{e}{2}} \qquad (5)$$

$$\tan(\alpha) \simeq \frac{e}{2} \quad (6)$$

$$F = mc^2 \frac{d \tan(\alpha)}{dx} \frac{\tan(\alpha)}{(1-\tan^2(\alpha))^{3/2}} \quad (7)$$

Therefore, using equations (6) and (7), we get, for the experiment 1):

$$F_1 \simeq \frac{mc^2}{4} \frac{de_1}{dx} e_1 \quad (8)$$

And we have also, for the experiment 2):

$$F_2 \simeq \frac{mc^2}{4} \frac{de_1}{dx} e_2 \quad (9)$$

Now, using (8) and (9) we get:

$$\frac{F_1 - F_2}{F_1} \simeq \frac{e_1{}^2 - e_2{}^2}{e_1{}^2} \quad (10)$$

$$\simeq 2 \frac{L_s}{L_u} \quad (11)$$

For getting equation (11), we have used equations (3) and (4) and the fact that L_u is much greater than L_s. However, it is also possible to get this equation (11) directly, using equation (1), and the help of equations (3) and (4).

For the estimation of L_s/L_u we will use an equation calculated in [9], in the case of "extended" matter contributions:

$$\frac{L_s}{L_u} = \frac{r_s}{r_g} \sqrt{\frac{\rho_s}{\rho_g}} \quad (12)$$

"Extended" matter means that the matter generating and propagating those space-time deformations is globally distributed among space, the opposite case being a single object, which is located only on some special location in space, and for which the distribution of matter is nearly a pin point mass distribution.

With equations (11), (12), and because of Newton's classical equation, this gives the same value for the corresponding ratio of G:

$$\frac{G_1 - G_2}{G_1} = \frac{F_1 - F_2}{F_1} \quad (13)$$

$$= 2 \frac{r_s}{r_g} \sqrt{\frac{\rho_s}{\rho_g}} \quad (14)$$

r_s stands for the maximum distance between the surrounding mountains, and the location of experiment 2). We will use $r_s = 10$ km.

r_g stands for greatest distance between a galactic object and the place of the experiments. We will use the same value as for the Pioneer anomaly calculation: $r_g = 9\ 10^{-2}$ kpc. This fitted value allowed to retrieve the Pioneer curve of figure 3. This value shows that the dust of the galaxy is acting like a fog for the matter located beyond it. Let's remind that this mechanism might solve also the sign issue mentioned above for the explanation of dark matter.

ρ_s is the mean matter density of the surrounding mountains of experiment 2). We will use $\rho_s = 2{,}7$ kg/m^3, which is the granite matter density.

ρ_g is the matter density of the galaxy. We will use the value $\rho_g = 0{,}709\ 10^{-20}$ kg/m^3, which is the matter density in the galaxy, near the solar system.

With those numerical values, the final result is the following.

$$\frac{G_1 - G_2}{G_1} = 4{,}4\ 10^{-3} \quad (15)$$

This theoretical value is close to the measured one, of equation (2). This proves that the order of magnitude of the measured difference can be explained by our correction of Newton's law.

The next step would be to get the information of the exact locations where the two experiments of [3] and [4] took places, to calculate precisely the theoretical ratio as above, and to compare this theoretical ratio to the measured one of equation (2).

As an intermediate conclusion, the gravitational model of this study, explained in [7], might explain very precisely the great historical disparity between the measurements of G.

We have shown that this value of G is depending on the distribution of matter in the surrounding neighbourhood (buildings, hills, mountains) of the place where the measurement of G is done.

Moreover, this study might give, with the help of our huge database of today G measurements, a precise value for the G' gravitational constant, which is our "classical" gravitational constant G, but valid only for very long distances.

Thereafter, with this value of G', it will be possible to predict the exact value of G at any distances and in any cases. Noticeably, whatever the distributions of the surrounding matter in the neighbourhood, it would be possible to calculate the value of G. This value of G will be valid only for the local application of Newton's law.

If this case, there is no doubt that the precision of the measurement of G', and the following calculation of G, will be much better than today, and with no longer disparities.

It must be pointed out also that the gravitational model of this document is predicting that the same measurement of G, done in two different places, will yield completely different values, and that this difference can be calculated by this model.

9. Conclusion

The gravitational model of the three elements theory is compatible by construction with restricted and general relativity. It seems to be compatible also with gravitation experimental measurements.
This model might explain, after some calculations, the following anomalies.

- earth flyby anomalies,
- perihelion precession of Saturn,
- disparity of the gravitational constant measurements.

But this model is actually giving an explanation for the following mysteries.

- dark matter mysteries,
- Pioneer anomaly,
- Saturn flyby by Pioneer 11.

As a conclusion, the gravitational model of the three elements theory seems to be validated. As such, this is a validation of the three elements theory itself.
A next step will be to solve the sign issue for the dark matter mystery (speed profiles).
But the most promising work would be the explanation of the disparity of the gravitational constant measurements. Indeed, the gravitational model of this document is predicting that the same measurement of G, done in two different places, will give completely different values, and that this difference can be actually calculated by this model.
Today this work consists first of getting the crucial information of the locations of two measurements of G, yielding different values. Thereafter, this work will be the evaluation of the presence of mountains in the neighbourhood of those locations. This will enable to calculate the theoretical ratio, and finally compare it to the measured one.
May we hope to solve someday the issue of the measurement of G ? Will we find a unique theoretical explanation for actual gravitation issues and physical mysteries ?

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