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GRAVITATIONAL MODEL OF THE THREE ELEMENTS THEORY

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Abstract
The gravitational model of the three elements theory is an alternative theory to dark matter. It uses a modification of Newton's law in order to explain gravitational mysteries. The results of this model are explanations for the dark matter mysteries, and the Pioneer anomaly. The disparities of the measurements of *G* might also be explained. Meanwhile, this gravitational model is perfectly compatible with restricted relativity and general relativity, and is part of the three element theory, a unifying theory.

1. Introduction
The three elements theory is a unifying theory. The gravitational model of the three elements theory is based on this theory. From construction, this theory is completely compatible with general and special relativity. This article compares the predictions of this model with the following topics:

- 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.

2. The gravitational model
This gravitational model is based on the inner mechanisms of restricted and general relativity. As a first consequence, it is perfectly consistent with relativity. Noticeably, PPN parameters (Parameterized Post-Newtonian formalism) are exactly the same as for relativity. Each of the Lorentz transformation details, space-time deformation by energy and following geodesics principles have been used in order to construct this gravitational model. Moreover, the attempt is to explain Lorentz transformation with the help of space-time deformation by energy principle. During this attempt, some inconsistencies are found. The resolution of these errors leads 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 us to recover 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 the “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
The theoretical curves are close to the measured ones. For example, Fig.1 shows the NGC 7541 theoretical speed profile.

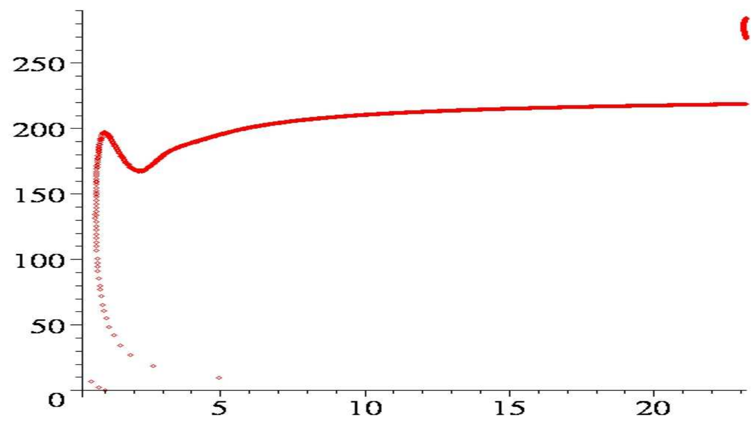

Figure 1: Theoretical speed profile for the NGC 7541 galaxy. X-coordinate is the distance from the galactic center, in kpc, and y-coordinate is the tangential velocity of the stars, in km/s. There are x-coordinate values corresponding each of them with more than one y-coordinate value. This is because this curve results from a simulation. This theoretical curve must be compared with an experimental one (Kyazumov 1989, Fig.3).

There is an issue of sign for those theoretical speed profiles. The measured curves are retrieved, but only when using an opposite sign for the equation of the gravitational force.
A plausible explanation of this error is an occultation mechanism during the propagation of the space-time deformations coming from the galaxy luminous points. This mechanism has been partially validated by calculations.
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 rely 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 relativistic cone:

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

In Eq. (1), *c* stands for the speed of light, and e_p stands for the energy of a luminous point. x_p is the distance between the considered luminous point and the point in space where *G* is calculated. The sum is done for each luminous point along a fixed width small space solid angle centered on the point in space where we want to calculate *G*.

4. The Pioneer anomaly

For the Pioneer anomaly (Turyshev 2010), the "first modification of Newton's law" is enough to retrieve a theoretical anomaly value equal to $A_t = 7.25 \times 10^{-10}\ m/s^2$, in place of the measured value $A_m = 8.74 \times 10^{-10}\ m/s^2$. But the shape of the theoretical curve is not perfect. Fig.2 shows this theoretical curve.

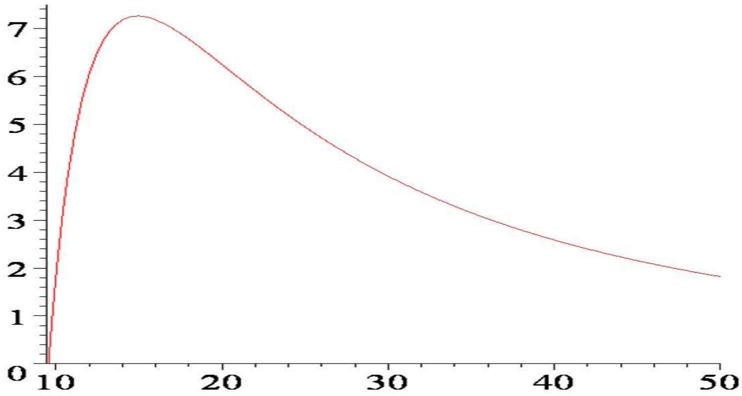

Figure 2: Theoretical curve of the Pioneer anomaly, using the "first correction of Newton's law". X-coordinate is the distance from the sun, in AU, y-coordinate is the added acceleration toward the sun, in 10^{-10} *m/s². This theoretical curve must be compared with an experimental one (Turyshev 2010, Fig.5.1).*

There is also a negative predicted anomaly for the probe's trajectory between the sun and Saturn (*x*-coordinate lesser than 10 *AU*). This work is in progress, and noticeably exact comparison with ephemerides must be done.
In order to retrieve the perfect curve, the "second modification of Newton's law" must be used also, taking into account the Kuiper 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 belt is a belt of asteroids located beyond the location of Saturn, along the ecliptic plane.
Now the result, on Fig.3, is very encouraging.

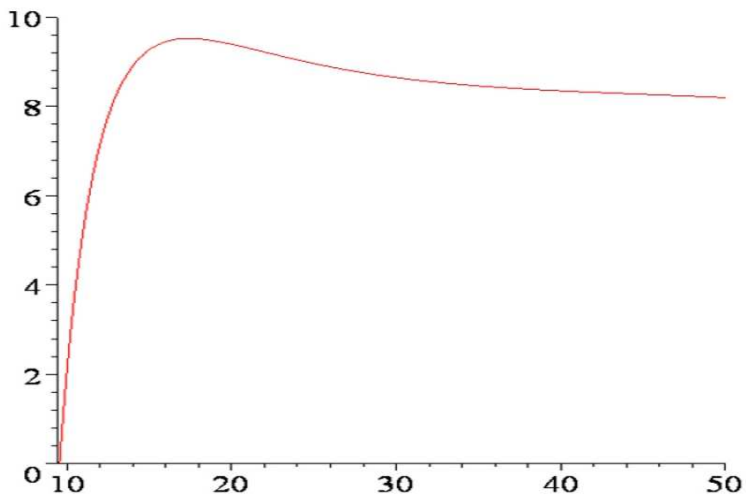

Figure 3: Theoretical curve of the Pioneer anomaly, using the "second correction of Newton's law". X-coordinate is the distance from the sun, in AU, y-coordinate is the added acceleration toward the sun, in 10^{-10} *m/s².*

On this theoretical curve, the maximum value is exactly $A_m = 8.74 \times 10^{-10}\ m/s^2$, the measured value.
But this theoretical curve has been obtained with fitted values for the Kuiper belt space-time deformation contributions. On the contrary, the curve of Fig.2 was calculated without any fitting.
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 an anomalous increase after the encounter.

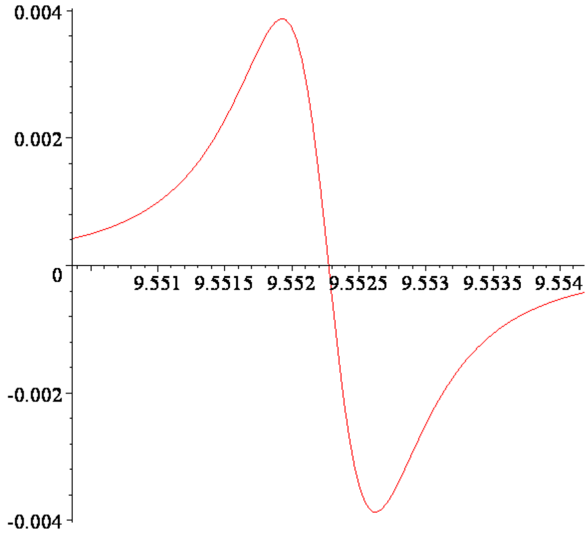

Figure 4: Theoretical curve of the Pioneer 11 anomaly, in the vicinity of Saturn. The calculation is using the "first and second modifications of Newton's law". X-coordinate is the distance from the sun, in AU, and y-coordinate is the anomalous acceleration toward the sun, in m/s². The represented anomaly is the sum of the Pioneer anomaly and the Saturn flyby anomaly.

5. Saturn perihelion and Earth flyby anomalies

For the Saturn perihelion anomaly (Iorio 2009), as well as for earth flyby anomalies (Anderson et al 2008), the "first modification of Newton's law" is not enough for giving explanations. The "second modification of Newton's law" must be conducted, which represents difficult calculations and needs an exact knowledge of the probes trajectories, and the ephemerides.

6. Measurements of G

The issue is well defined. For nearly three centuries, *G* has been measured, without getting roughly a better precision than 0.7 %. The reason of this poor precision is the fact that many measurements values are contradicting each others, taking into account their confident interval (Gillies 1997).
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 compare first with "sideral gravity" experimental data (Gershteyn et al 2002). A prediction of the model of the three elements theory is that the *G* value is depending of the surrounding matter distribution. This is not a new idea, it has been suggested before (Gershteyn et al 2004). Moreover, it has been proven by experimental data (Gershteyn et al 2002), that the value of *G* depends of the orientation. This behavior is also a consequence of this theoretical idea. The amplitude of the variation of the *G* value is more than 0.054% as compared to its absolute value (Gershteyn et al 2002). The prediction of the gravitational model of the three elements theory for this value is between 1% and 0.013% depending of extra-galactic contributions. Therefore, the order of magnitude of this model prediction is compatible with experimental data.
Now let's try another estimation, not taking in account the presence of the stars, but the presence of mountains around the apparatus during the measurement of *G*. The ratio below is the relative difference between two values of *G*, G_{1m} (Michaelis et al 1995), and G_{2m} (Bagley and Luther 1997).

$$\frac{G_{1m} - G_{2m}}{G_{1m}} = 6.5 \times 10^{-3} \qquad (2)$$

Those two official measurements of *G* have been chosen in order to get the greatest possible ratio above.

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

- Experiment {1}, for example, is done at the very top of a hill on the floor of a desert, and this floor is completely plane outside of the hill on which we are located.
- Experiment {2}, 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 is used and the same measurement procedure is applied. Indeed, the presence of the surrounding mountains in the second measurement has an important effect on the final measured value:

$$\frac{G_1 - G_2}{G_1} \simeq 0.9 \times 10^{-3} \qquad (3)$$

This theoretical value is not far from 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.
As an intermediate conclusion, the gravitational model of this study might explain very precisely the great historical disparity between the measurements of *G*.
It has been shown that this theoretical value of G might depend on the distribution of matter in the surrounding neighborhood (buildings, hills, mountains, and sea) of the place where the measurement of G is done. Moreover, this study might give, with the help of our database of today G measurements, a precise value for the G' gravitational constant. This G' value is the "classical" gravitational constant G, but valid only for an empty neighborhood, inside the galaxy. Thereafter, with this value of G', it will be possible to predict the exact value of G at any distances and in any cases inside the galaxy. Noticeably, whatever the distributions of the surrounding matter in the neighborhood, 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. In this case, there is no doubt that the accuracy of the measurement of G', and the following calculations of G, will be much better than today, and with no longer disparities.

7. Conclusion

The gravitational model of the three elements theory is compatible by construction with restricted and general relativity. The PPN parameters are exactly the same as for 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.

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. The next step will be to realize the two specific measurements of *G* in order to check the prediction of this model.

8. Bibliography

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