Mercury's perihelion advance is caused by our Milky Way.

Based upon the book "Gravitomagnetism" – Thierry De Mees

1. Introduction : the Maxwell analogy for gravitation: a short history.

Several studies have been made earlier to find an analogy between the Maxwell formulas and the gravitation theory. Heaviside O., 1893, predicted the field. This implies the existence of a field, as a result of the transversal time delay of gravitation waves. Further development was also made by several authors. L. Nielsen, 1972, deducted it independently using the Lorentz invariance. E. Negut, 1990 extended the Maxwell equations more generally and discovered the consequence of the flatness of the planetary orbits, Jefimenko O., 2000, rediscovered it, deducted the field from the time delay of light, and developed thoughts about it, and M. Tajmar & C.de Matos, 2003, worked on the same subject.
This deduction follows from the gravitation law of Newton, taking into account the time delay caused by the limited speed of gravitation waves and therefore the transversal forces resulting from the relative velocity of masses. The laws can be expressed in the equations (1) to (5) hereunder.
The formulas (1.1) to (1.5) form a coherent set of equations, similar to the Maxwell equations. Electrical charge is then substituted by mass, magnetic field by gyrotation, and the respective constants as well are substituted (the gravitation acceleration is written as $\boldsymbol{g}$, the so-called "gyrotation field" as $\boldsymbol{\Omega}$, and the universal gravitation constant as $G^{-1} = 4\pi\,\zeta$, where G is the "universal" gravitation constant. We use sign $\Leftarrow$ instead of = because the right hand of the equation induces the left hand. This sign $\Leftarrow$ will be used when we want to insist on the induction property in the equation. $\boldsymbol{F}$ is the induced force, $\boldsymbol{v}$ the velocity of mass m with density ρ.

$$\boldsymbol{F} \Leftarrow m\,(\boldsymbol{g} + \boldsymbol{v} \times \boldsymbol{\Omega}) \qquad (1.1)$$

$$\nabla \cdot \boldsymbol{g} \Leftarrow \rho / \zeta \qquad (1.2)$$

$$c^2\, \nabla\times \boldsymbol{\Omega} \Leftarrow \boldsymbol{j} / \zeta + \partial \boldsymbol{g} / \partial t \qquad (1.3)$$

where $\boldsymbol{j}$ is the flow of mass through a surface. The term $\partial \boldsymbol{g}/\partial t$ is added for the same reasons as Maxwell did: the compliance of the formula (1.3) with the equation

$$\text{div}\, \boldsymbol{j} \Leftarrow -\, \partial\rho / \partial t$$

It is also expected

$$\text{div}\, \boldsymbol{\Omega} \equiv \nabla .\, \boldsymbol{\Omega} = 0 \qquad (1.4)$$

and

$$\nabla\times \boldsymbol{g} \Leftarrow -\,\partial\, \boldsymbol{\Omega} / \partial t \qquad (1.5)$$

All applications of the electromagnetism can from then on be applied on the *gravitomagnetism* with caution.
Also it is possible to speak of gravitomagnetism waves, where

$$c^2 = 1 / (\zeta\, \tau) \qquad (1.6)$$

where $\tau = 4\pi G/c^2$.

2. **The link between Relativity Theory and Gyrotation Theory.**

Two flows of masses $\dot{m}$ moving in the same way in the same direction, attract. Whether one observer follows the movement or not, the effect must remain the same when we apply the relativity principle.

The two points of view are compared hereunder.

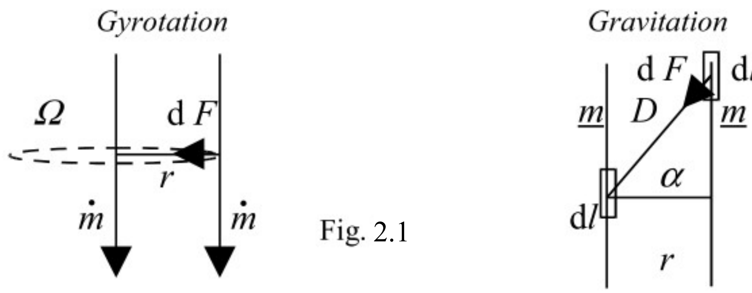

Fig. 2.1

The following notations are used:

$$\dot{m} = \mathrm{d}m/\mathrm{d}t \qquad \text{and} \qquad \underline{m} = \mathrm{d}m/\mathrm{d}l$$

For the *gyrotation* part, the work can be found from the basic formulas in sections 1 until 3 :

$$\underline{F} \Leftarrow \Omega\,\dot{m} \quad \text{and} \quad 2\pi\, r.\Omega \Leftarrow \tau\,\dot{m}$$

where $\underline{F} = \mathrm{d}F/\mathrm{d}l$ and $\tau = 4\pi\ \mathrm{G/c}^2$.

So,

$$\underline{F} = 2\ \mathrm{G}\ \dot{m}^2 /(r\ \mathrm{c}^2)\ . \qquad \text{Now} \quad \dot{m} = \underline{m}.v$$

Hence, the work is :

$$\underline{F}.\mathrm{d}r = 2\ \mathrm{G}\ \underline{m}^2\, v^2/(r\ \mathrm{c}^2)\ \mathrm{d}r \tag{2.1}$$

For the *gravitation* part, the gravitation of $\underline{m}$ acting on $\mathrm{d}l$ is integrated, which gives :

$$\underline{F} = 2\ \mathrm{G}\ \underline{m}^2 / r$$

The work is :

$$\underline{F}.\mathrm{d}r = 2\ \mathrm{G}\ \underline{m}^2/r\ \mathrm{d}r \tag{2.2}$$

Let's assume two observers look at the system in movement: an observer at (local) rest and one in movement with velocity v.
An observer at rest will say: the system in movement will exercise a work equal to the gravitation of the system at rest, increased by the work exerted by the gyrotation of the system in motion.
A moving observer will say: the system will exert a work equal to the gravitation (of the moving system).
Because of the principle of relativity, the two observers are right. One can write therefore:

$$\frac{G\left(\underline{m}_{\mathrm{st}}\right)^2_{st}}{r} + \frac{G\left(\underline{m}_{\mathrm{v}}\right)^2_{st} v^2}{r\,\mathrm{c}^2} = \frac{G\left(\underline{m}_{\mathrm{st}}\right)^2_{v}}{r} + 0 \tag{2.3}$$

where "$(\underline{m}_v)_{st}$" e.g. represents the moving mass, seen by the steady observer.
We can assume (due to the relativity principle) that:

$$(\underline{m}_{st})_v = (\underline{m}_v)_{st} \;. \qquad \text{Hence,} \qquad (\underline{m}_{st})_{st} = (\underline{m}_v)_{st}\sqrt{1-v^2/c^2}$$

An important consequence of this is: the "relativistic effect" of gravitation, or better, the time delay of light is expressed by gyrotation. This could be expected from the analogy with the electromagnetism.
In other words: when the gravitation and the gyrotation are taken into account, the frame can be chosen freely, while guaranteeing a "relativistic" result.

The fact that the neutron stars don't explode can find its explanation through the forces of gyrotation, but can also be seen as a "mass increase" due to the relativistic effect. The mass increase of the relativity theory is however an *equivalent pseudo mass* due to the gyrotation forces which act locally on every point.

3. What is causing the classical Mercury's perihelion advance?

The Mercury's perihelion advance.

The Newtonian control calculation of the astronomic values of the perihelion advance was performed by Leverrier in 1859, and was reassessed and improved by Newcomb in 1895. The interpretable advances of Mercury's perihelion are due to:

1. the progress of the equinox which explains 5025" per century;
2. the perturbation by the planets for total of 526",7 per century.

Unexplainable compared with the overall astronomic observation is a surplus of 43" per century.

The missing advance of Mercury's perihelion explained by the sun's motion in the Milky Way.

Let us examine which outcome is obtained with the Maxwell Analogy. Based on the theor
Jefimenko found that a mass which moves in relation to an observer, experiences an extra force. A moving mass

For Mercury we must take into account the local stationary gravitation in which Mercury is immersed. The "immobile" gravitation of the sun can be a reference field with which the gravitation field of Mercury is in "interference", creating this way a field, similar to a magnetic field, called *gyrotation field*.

In my work [5] I have calculated, starting from the Maxwell Analogy, that all stars of our Milky Way revolve with a speed of roughly speaking 240 km/s. This was based on a galactic system of which the central bulge was valued on 10% of the total mass of the galaxy. The literature finds strongly divergent masses for this bulge, what makes an exact calculation difficult. At present one values the speed v_1 of the sun between 220 and 250 km/s, what closely join our quick calculation.

From the Maxwell Analogy follows the property, for an uniform moving spherical mass M (the sun) in a local gravitation field (the Milky Way) , that an extra force is exerted on any mass that lays perpendicularly on the movement direction. We come to it as follows: if we isolate a random thin ring of the sphere in a plane, perpendicularly on the rotation vector ω , the uniform motion v in a gravitation field will be associated with an extra force F on the mass m that is perpendicular on ω and v .

The rotation (spin) of the sun is not considered here, only the translation. The sun travels through the Milky Way at 60° inclination with the disc (fig. 3.1). Then, the gyrotation field surrounding the Sun will act under an angle of 30° with Mercury's orbit, and account for half of the value (= *cos* 60°), when Mercury's orbit is projected on the plane of the Milky Way's disc.

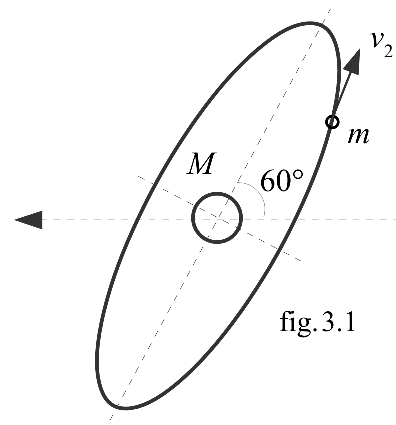

fig. 3.1

From my section "The link between Relativity Theory and Gyrotation Theory", the left hand of eq.(2.3) , it follows that the gyrotational force equals now half of v^2/c^2 times the gravitational force. And, in any orbital position of mass *m* , it is possible to adapt fig. 3.1 so that at each time, we can observe how the gyrotation acts on *m*. Thus, the gyrotation force acting on *m* equals

$$-F_{\Omega\, a} = G\,\frac{m\,M}{2\,r^2 c^2}\,v^2 \qquad (3.1)$$

in which *v* is the average velocity between the sun's gyrotation and Mercury's velocity v_2 that has to be taken into account in the equation (1.1) of the Lorentz-like force.

In fig. 3.2 , the sun with mass M and radius R is considered at an average distance r of Mercury, which has mass m , and resides at a certain instant under angle α in relation to an axis going through the centre of the Milky Way. We approximate the elliptic orbit by a circular one.

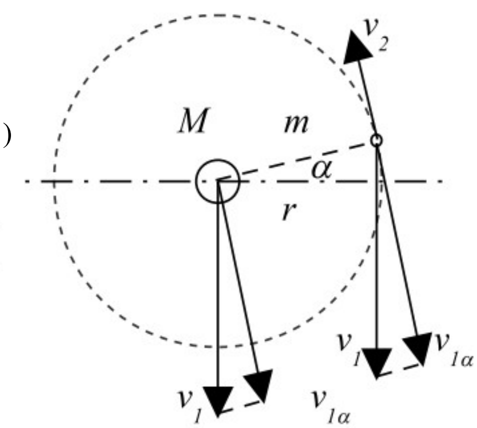

fig.3.2

Hence, under the angle α , Mercury experiences therefore the following instant force by the sun :

$$-F_{\alpha} = G\,\frac{m\,M}{2\,r^2\,c^2}\,v_1^{\,2}\cos^2\alpha \qquad (3.2)$$

When we know that Mercury revolves with an average speed v_2 equal to 47,9 km/s, and the sun with a estimated velocity v_1 equal to 235 km/s in the galaxy, what means that, expressed in v_2 , we can write that $v_1^{\,2} = 24\,v_2^{\,2}$ with good approximation. Hence, the equation (3.2) can therefore be written as:

$$-F_{\alpha\,2} = 12\,G\,\frac{m\,M}{r^2\,c^2}\,v_2^{\,2}\cos^2\alpha \qquad (3.3)$$

We can eliminate α by taking the average value over the whole orbit. Therefore, we integrate (3.3) over α from $-\pi/2$ to $+\pi/2$ and get half of the total impact. Doubling this result gives the total effect over the whole circumference (it does not annihilate the first half circumference because the velocity vector changes sign). Dividing the result by 2π gives us the average over the whole circumference :

$$-F_2 = 6\,G\,\frac{m\,M}{r^2\,c^2}\,v_2^{\,2} \qquad (3.4)$$

this brings us to: $\delta = 6\,v_2^{\,2} / c^{\,2}$

This result, obtained by using the Maxwell Analogy, is exactly the value which was obtained by Einstein by using the Relativity Theory.

I must admit that I have chosen the sun's velocity v_1 exactly equal to 235 km/s, so that I obtain the aimed result. In fact we probably should choose the real speed v_1 somewhat lower, but also correct the result for δ with some arc seconds because of the gyrotational perturbation by the other planets. They indeed also exert the three described forces on Mercury, of whose the force related to the orbit speed is the most important one, following the Newton force. Of course, Le Verrier originally could only take into account the Newton forces, as we did.

Conclusion: the Maxwell Analogy explains Mercury's perihelion advance.

With the classical application of the Maxwell Analogy, it is perfectly possible to explain Mercury's perihelion advance completely. Not the bending of the universe, but the motion of the sun and Mercury in the Milky Way is responsible for it.

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