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The calculation of the bending of star light grazing the sun.

Described by using
Gravitomagnetism.

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Abstract

In this paper, I refocus on the second one of the findings that I described in my paper: *Did Einstein cheat?* The precise and detailed bending of star light grazing the sun can be found for light rays, just by applying the Maxwell Analogy, or gravitomagnetism (which has firstly been suggested by Heavyside at the end of the 19th century) and by using the sun's orbital motion and its rotation. I find that the bending on the sun' poles complies with the measured values, and I find different bending at the left and the right side of the sun. Also observation confirms an asymmetric deviation of light, depending on the latitude where the star light grazes the sun.

Key words : *bending of light, gravitomagnetism, relativity theory.*
Method : *analytical.*

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1. The Maxwell Analogy for gravitation: equations and symbols.

For the basics of the theory, I refer to : “A coherent double vector field theory for Gravitation”. The laws can be expressed in equations (1.1) up to (1.6) below.

The electric charge is then substituted by mass, the magnetic field by *gyrotation*, and the respective constants are also substituted. The gravitation acceleration is written as $\boldsymbol{g}$, the so-called *gyrotation field* as $\boldsymbol{\Omega}$, and the universal gravitation constant out of $G^{-1} = 4\pi\,\zeta$, where G is the universal gravitation constant. We use sign $\Leftarrow$ instead of = because the right-hand side of the equations causes the left-hand side. This sign $\Leftarrow$ will be used when we want insist on the induction property in the equation. F is the resulting force, v the relative velocity of the mass m with density ρ in the gravitational field. And $\boldsymbol{j}$ is the mass flow through a fictitious surface.

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

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

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

$$div\, \boldsymbol{j} \Leftarrow -\, \partial\rho \,/\, \partial t \qquad (1.4)$$

$$div\ \boldsymbol{\Omega} \equiv \nabla.\ \boldsymbol{\Omega} = 0 \qquad (1.5)$$

$$\nabla \times \boldsymbol{g} \Leftarrow -\, \partial \boldsymbol{\Omega} \,/\, \partial t \qquad (1.6)$$

It is possible to speak of gyrogravitation waves with transmission speed c.

$$c^2 = 1 \,/\, (\,\zeta\,\tau\,) \qquad (1.7) \qquad \text{wherein} \qquad \tau = 4\pi\, G/c^2.$$

2. The bending of star grazing the sun.

2.1 The bending due to the light's velocity c.

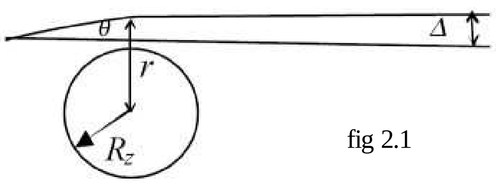

fig 2.1

When light grazes the sun we find again several forces with the Maxwell analogy. Since the rest mass of light rays is zero *we must not consider the gravitation force of Newton!*

Only a mass at speed c must be taken into account, and this will generate a gyrotation force. Jefimenko calculates the gyrotation of a mass flow with velocity v , radius a and density ρ at a distance r , measured perpendicularly to the mass flow, equation (13-2.2)[5] . This is in total equivalence with the magnetic field of a long beam of charged particles :

$$\Omega = -\,G\,\frac{2\,\pi\,\rho\,a^2}{r^2\,c^2}\,v \qquad (2.1)$$

For light we set $c=v$, and the mass per length unit $\underline{m} = \pi\,\rho\,a^2$.

$$\Omega = -\,G\,\frac{2\,\underline{m}}{r^2\,c} \qquad (2.2)$$

Using (1.1) in which we set $g=0$, we find the radial force per length unit :

$$\underline{F}_{\,r,\Omega} = -\,G\,\frac{2\,\underline{m}\,M}{r^2} \qquad (2.3)$$

Of course its validity remains for each length of the light ray.

2.2 The bending due to the Sun's orbital velocity in the Milky Way's gyrotation field.

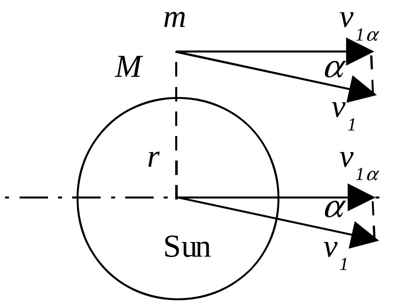

fig.2.2

The radial force caused by the velocity v_1 , i.e. the orbit revolution velocity of the sun in the Milky Way, is given by the equation (2.1) of my paper *"Mercury's perihelion advance is caused by our Milky Way"* for the sun's translation velocity (written in full in the second term of equation (2.3) in that paper) . For a light beam, we have a mass per unit of length $\underline{m}$, M is the sun's mass, r the distance between the sun and the light ray, v_1 the orbital velocity of the sun in the Milky Way, and α the angle between the sun's orbital velocity and the direction of the incoming light ray. Let the angle ϕ be the angle between the light beam and the Milky Way's equator. Hence, the equation of the radial force becomes:

$$-\underline{F}_{r,\alpha,v1} = G \frac{\underline{m}\, M}{2\, r^2 c^2}\, v_1^{\,2}\, \cos^2\alpha \cos^2\phi \qquad (2.4)$$

2.3 The bending due to the Sun's rotation.

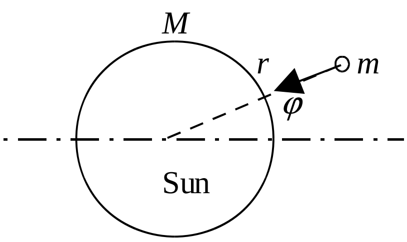

Fig.2.3 : sun's latitude φ.

As last radial force we get the one of (6.7), whereof the size depends on the spin of the sun, and of course of the latitude φ along which the light ray passes (see fig.2.3). The sun has actually a *differential* spin ω which varies according to the latitude φ : the poles rotate 30% more slowly than the equator. If we assume that, with respect to the sun, the speed of the passing star light is the constant c, one may not take into account the speed $v_1 \cos\alpha$ of fig.2.2 in this term. The equation we are looking at has been obtained in equation (2.2) of my paper *"Mercury's perihelion advance is caused by our Milky Way"* (written in full in the third term of equation (2.3) in that paper) . It is the second term of that equation, which describes the radial attraction to the surface of the sun. The equation (2.5) below has of course been adapted to the symbols used here.

$$-\underline{F}_{r,\varphi} = G \frac{\underline{m}\, M\, R\, \omega_\varphi}{5\, r^2 c} \cos\varphi \cos\theta \qquad (2.5)$$

In equation (2.5) , I have detailed the case where $R \neq r$, wherein R is the sun's radius and r the distance to the light beam. The angle θ is the angle between the light beam and the sun's equator, and φ represents the latitude's angle. In my paper "*Did Einstein cheat?*", I have supposed that $R = r$. The definition of the "average local rotation velocity" ω_φ is not very precise, but it will be close to (slightly more than) the "local rotation velocity" at the latitude φ .

2.4 The total radial bending of light, grazing the sun.

The total radial force is this way:

$$-\underline{F}_{\varphi,\alpha,\phi,\theta} = G\,\frac{2\underline{m}\,M}{r^2} + G\,\frac{\underline{m}\,M}{2\,r^2\,c^2}\,v_1^{\,2}\cos^2\alpha\cos^2\phi + G\,\frac{\underline{m}\,M\,R\,\omega_\varphi}{5\,r^2\,c}\,\cos\varphi\cos\theta \tag{2.6}$$

The bending of light over the poles is therefore exactly the double of the calculation according to Newton, but moreover there is an extra bending according to the position of the earth relative to the sun and to the Milky Way, and an extra bending which varies according to the latitude on the sun along which the light ray passes. The last term is positive (attraction bending) at the left side of the sun and negative (repulsion bending) at its right side, because of the spin direction of the sun.

3. Discussion and conclusion: the Maxwell Analogy explains the bending of light that is grazing the sun.

With the classical application of the Maxwell Analogy, it is perfectly possible to explain the bending of light completely. The overal bending, which has been described by the General Relativity Theory of Einstein, has been deducted here in a classical and analytical way. More specified deviations of that bending have been found as well, which are dependent of the angle α of the light ray in relation to the sun's orbital motion inside the Milky Way.
The bending effect is positive (attraction) or negative (repulsion), depending if the light ray follows the sun's galactic orbit or not. When the light ray and the orbit have the same velocities' directions, we get attraction, but at inversed velocities' directions, we get repulsion.
Finally, the own rotation of the sun also changes the light ray's deviation, and this depends from the latitude's angle φ , because of the differing “average local velocity” of each latitude at the sun's surface.
This last bending effect on the light ray is positive or negative, depending of side of the sun along which the light ray passes. When the light ray goes against the sun's rotation, it is negative, and at the same velocities' direction it is positive.

4. References and interesting literature.

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