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Does gravity conserve angular momentum at a distance?

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Abstract. We found [4] that the key for many cosmic events lays in gravity, which is very well explained by gravitomagnetism, as suggested by O. Heaviside and further developed as a causal and coherent theory by O. Jefimenko. The angular momentum of spinning objects is transmitted to the surroundings by gravity, and form the rings of Saturn and the disc galaxies. In this paper, we analyze what happens with the gravity fields of collapsing stars. It is found that not only the mechanical angular momentum is regulating the orientation of disc galaxies. The magnetic-like component of gravity, which is velocity-dependent, is found to create forces that are consistent with the conservation of angular momentum. However, the retardation of the gravity fields by the speed of light, which is velocity-dependent, is found to cause a discrepancy between the mechanical angular momentum and the transmitted gravitational angular momentum.

Keywords: gravitomagnetism, Jefimenko, Heaviside, disk galaxy, angular momentum.

Introduction

Many examples from our Solar system and from the cosmos have proven that O. Heaviside [1] and O. Jefimenko [2] were right about gravitomagnetism [4].

Let us have a closer look at this theory. Earlier, we have found that disc galaxies are flattened by the angular momentum that is contained in the galaxy's bulge [4]. In this paper will be shown that not the mechanical angular momentum of the spinning stars is regulating the galaxy disc's orientation, but instead the gravitational angular momentum.

1. A word on gravitomagnetism

Before we get to the core of the matter, we need to understand a bit about gravitomagnetism. How does gravitomagnetism work in a nutshell? It states that there exists, in addition to the Newtonian gravity, a second gravity field $\mathbf{B}_g$ that is exclusively caused by the motion of masses, when these masses move inside a static gravity field.

This is totally analogous to the creation of a magnetic field by a moving charge.

When another mass moves inside that second gravity field, it gets a transverse force $\mathbf{F}$ that is perpendicular on both the gravity field vector and the velocity vector.

$$\mathbf{F} = m\,(\mathbf{v}\times\mathbf{B}_g) \tag{1}$$

wherein $\mathbf{v}$ is the velocity vector of the mass m.

(I call "gyrotation" the second gravity field $\mathbf{B}_g$ and I used the symbol $\mathbf{\Omega}$ instead of $\mathbf{B}_g$ all of my works) [3] [4].

The eq.(1) is totally analogous to the Lorentz force in electromagnetism.

A spinning object like the Sun will generate a gyrotation field that is alike a magnetic field between the poles of a magnet.

It is found that for an orbiting planet with a velocity v_2, the global gravitational acceleration is given by [11]:

$$a = -\frac{G\,m}{r^2}\left(1+\frac{v_2\,\omega R^2}{5\,r\,c^2}\right) \tag{2}$$

The first term is the Newtonian part, the second term, the velocity-dependent gravity term. We know that the angular momentum for a sphere is

$$L = I\omega = \frac{2}{5}mR^2\omega \tag{3}$$

Indeed, if the star would collapse, its radius would reduce, but its angular velocity would increase according to the conservation of angular momentum. Also the acceleration of eq.(2) which is also caused by the velocity of masses, respect this conservation

of angular momentum. And thus, the angular momentum is conserved in the case of gravitomagnetism for steady systems, in which the retardation of the fields by the speed of light is not considered.

2. Gyrotation effects due to field retardation

One of the most remarkable contributions of Oleg Jefimenko is that he developed gravitomagnetism while taking into account the distances between the source and the receptor by taking into account the retardation of the fields by the speed of light [2]. His theory is strictly based upon Oliver Heaviside's suggestion that electromagnetism and gravity might be totally similar, since the Coulomb force and the Newtonian gravity force look similar [1].

When the motion of a mass at a velocity v is analyzed, it was found by Heaviside and confirmed by Jefimenko that the retarded fields of (Newtonian) gravity, by the speed of light, in a given point P at a present distance r_0 change by the following equation:

$$\mathbf{g} = -G\frac{m\left(1-v^2/c^2\right)}{r_0^3\left[1-\left(v^2/c^2\right)\sin^2\theta\right]^{3/2}}\mathbf{r}_0 \qquad (4)$$

with θ the angle with the line of motion. The easiest to understand this is to consider an accumulation of gravity fields, analogous to the accumulation of sound about a supersonic airplane.

From this eq.(4) follows that in the line of motion ($\theta = 0$), the detected gravity field will be reduced according to:

$$g = -G\frac{m\left(1-v^2/c^2\right)}{r_0^2} \qquad (5)$$

and perpendicularly ($\theta = \pi/2$), the detected gravity field will, for high speeds, explosively be augmented according to:

$$g = -G\frac{m}{r_0^2\left(1-v^2/c^2\right)^{1/2}} \qquad (6)$$

In the cosmos, the most frequently present large objects are spinning and orbiting stars. When considering the star's radius much smaller than the distance r_0 to the point P, the average of eq.(4) in P can be found by integrating eq.(4) over an angle $\pi/2$.

The result is that at very high velocities, stars will get an apparent mass that is several times larger than its original mass. Hence, if the center of a disc galaxy contains huge, fast spinning stars that collapse, the angular momentum transmitted by gravity will be greater than its mechanical angular momentum.

In my earlier papers, I have spoken of angular momentum, but in some cases we meant it as "mechanical angular momentum" and in other cases as "gravitational angular momentum" and named it the "transmitted angular momentum". Since the effect of eq.(4) was never considered until now, this didn't matter much. However, from now on we will make a clear difference between both types of angular momentum.

3. Conclusion: is the conservation of angular momentum respected by gravity at a distance?

At the first glance, the conservation law of angular momentum would forbid a change. However, the answer is no, it isn't when very high speeds are taken into consideration. Here, we found one of the most intriguing causes of this change, by the non-conservation of mechanical angular momentum by gravity, at high spins, after a strong star collapse.

Since disc galaxies are flattened by the global angular momentum of its bulge, the formation of bar galaxies occurs when a.o. the bulge's angular momentum changes dramatically. It is evident that the increased angular momentum that is transmitted by gravity after a star collapse, may drastically change the global angular momentum in the bulge of a disc galaxy, and cause a bar galaxy to form.

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