The torsion of space by a rotating star

M.G. Gadzhiev

Abstract

It is established that the torsion of physical space can be complete when the rotation speed of the space on the surface of the object coincides with the rotation speed of the object itself, and incomplete when the space on the surface rotates slower than the object. Based on formulas for calculating the perihelion displacement of the planets of the solar system,

The formula for the torsion coefficient of physical space q was obtained. Numerical values of the torsion coefficient were obtained for the Sun (q=3/4) and for the Earth (q=0.00001), which is confirmed by observations of the displacement of the perihelions of the planets of the Solar System and the Moon. Considering that the torsion coefficient formula includes physical parameters in the form of the gravitational Schwarzschild radius, the problem of twisting space by a black hole is considered. It has been established that the angle of displacement of the perihelion of a black hole satellite can reach a value of 3π per revolution, that is, its angular velocity will increase by 2.5 times. Given the total curvature of space by the black hole, a limit of 4,6 revolutions per minute is obtained for the minimum rotation speed of the black hole. The formula of the torsion velocity function of physical space is derived, which depends only on the radius and angular velocity of the star rotation, and does not depend on its mass and the magnitude of the gravitational force. This function is a guide for the gravitational force and therefore has a physical meaning of the trajectory of free fall of bodies in the twisted physical space. It is established that the direction of deflection of the trajectories of free-falling bodies, including light rays, depends on the direction of rotation of the star.

Keywords: gravity, physical space, torsion, perihelion, Schwarzschild radius, black hole..

Contents

1 Introduction

The reliability of any theory is assessed by the extent to which its conclusions and calculations are consistent with observational and experimental data. In this sense, the anomalous displacement of the perihelion of Mercury was the first and significant confirmation of the theory of relativity, since the results of calculations based on the formula derived from the theory coincided with the observational data with accuracy up to the error of the instruments. This was the first experience of applying the equations of general relativity [1] to calculate gravitational effects that had no explanation in the framework of Newtonian mechanics. According to the theory of relativity, the cause of the anomalous displacement of the perihelion of the planets of the solar system are relativistic effects caused by the deformation of space-time. Considering that the anomalous displacement of the perihelion of the planets occurs in the direction of the rotation of the Sun, it can be assumed that the torsion of space by a rotating mass may also be the cause of the anomalous displacement of the perihelion. And what is the torsion of space? If you, at the equator of a rotating planet, throw a stone vertically upwards and it falls on your head, then the space around the planet is maximally twisted and rotates with it. In all other cases, there is a partial torsion of space or its absence. With full torsion, the stone retains angular velocity, and in the absence of torsion, the stone retains tangential velocity. In reality, the degree of torsion depends on the mass and speed of rotation of the object, and it will always fade away from the object, since the influence of its rotation cannot extend indefinitely. In an extensive article by Ginzburg V.L. [2] devoted to the experimental verification of the general theory of relativity, it is noted that according to the equations of the theory of relativity, the contribution of the rotation of the Sun to the anomalous displacement of the perihelion of Mercury will not only be small, but also negative. Therefore, the influence of the rotation of the Sun on the movement of planets in orbit is neglected in the theory of relativity. In Newtonian mechanics, there is no explanation for the anomalous displacement of the perihelion planets, otherwise this problem would have been solved back in the XIX century. Moreover, it seems interesting to postulate the possibility of torsion of space by a rotating object and to investigate the effect of such torsion on the dynamics of planetary systems.

2 Calculation of the torsion of space by a rotating star

The hypothesis of the torsion of space, as well as the possibility of curvature of space-time in the theory of relativity, is based on the assumption that space has such physical properties as uniformity, continuity, and continuity. The difference lies in the fact that the causes of anomalous phenomena in the motion of planets are considered not relativistic effects associated with changes in the geometric properties of space-time, but the torsion of physical space under the influence of rotation of gravitating masses. Consider a star of mass M, radius r_s, rotating with angular velocity ω. With full torsion of space by a rotating star, the tangential velocity of space at the equator coincides with the tangential velocity of the star and is equal to $u_s = \omega r_s$. Figure 1.2 shows graphs of the functions of the torsion velocities of space U(r) as a function of the distance to the center of the star in a movable and fixed coordinate system. For the convenience of the image, the star in Fig.1 rotates clockwise, and in Fig.2 - counterclockwise.

If the entire space rotates in the same way as the star, then the tangential velocity of space in a fixed coordinate system increases in proportion to the radius (line 1 in Fig.1,2). If space is not swirled by a star, then its tangential velocity is zero regardless of the radius (line 2 in Fig.1,2). If there is a

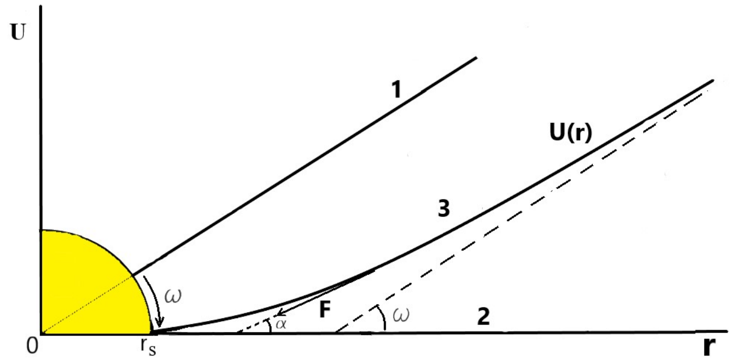

Figure 1: The direction of the flow of physical space V and the force of gravity of the Sun F.

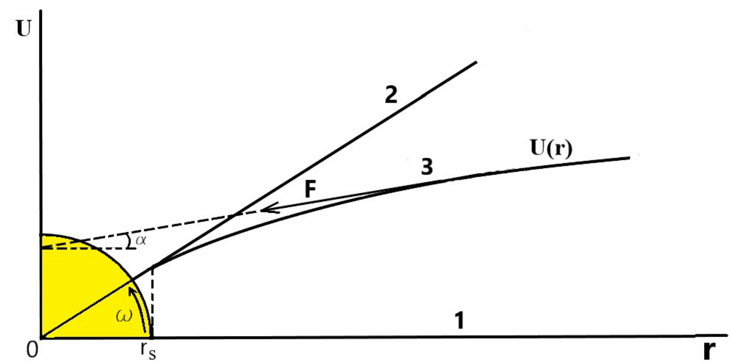

Figure 2: The results of calculating the displacement of the perihelion planets

complete torsion of space on the surface of the star, then the gravitational force on the surface is directed to the center of the star and its projection to the tangential direction in the coordinate system rotating with the star is zero (Fig.1). Due to the fact that in the far zone the torsion of space tends to zero with distance from the surface, the direction of the gravitational force deviates from the direction of line 2 and approaches the direction of line 1. Thus, the angle $\alpha(r)$ between the force of gravity and the direction to the center, in the coordinate system rotating with the star, is zero on the surface of the star and tends to ω at infinity. In a fixed coordinate system, this angle is equal to ω on the surface of the star and tends to zero at infinity. Here ω is a dimensionless rotation angle in radians, numerically equal to the angular velocity of rotation of the star. The simplest function satisfying these conditions is the function:

$$\alpha(r) = \omega(1 - r_s/r); (1)$$

If we move from a moving coordinate system rotating with a star to a fixed coordinate system associated with distant stars, in which the displacement of the perihelion planets in the solar system is observed, then the function (1) will take the form:

$$\alpha(r) = \omega - \omega(1 - r_s/r) = \omega r_s/r; (2)$$

The projection of the gravitational forceF on the radial direction is calculated according to the law of universal gravitation:

$$F_r = F \cos \alpha(r) = -\frac{GMm}{r^2};$$

and the projection of the gravitational force on the tangential direction has the form:

$$F_\theta = F \sin \alpha(r) = F_r \tan \alpha(r) = -\frac{GMm\omega r_s}{r^3};$$

It is taken into account here that in a fixed coordinate system on the surface of the star exactly, and then everywhere and with high accuracy, the condition is fulfilled

$$\tan \alpha(r) = \omega r_s/r;$$

Tangential acceleration can be expressed through the tangential projection of the gravitational force:

$$a_\theta(r) = F_\theta/m = \frac{GM\omega r_s}{r^3};$$

which leads to an increase in the path of the planet's orbit over time t by an amount:

$$S = a_\theta(r)t^2/2 = \frac{GM\omega r_s t^2}{2r^3}; (3)$$

Using Kepler's third law in the form:

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM};$$

where T is the period of rotation, from (3) we obtain an expression for the linear anomalous displacement of the perihelion planets in one revolution in the form:

$$S = 2\pi^2 \omega r_s; (4)$$

From the observational data of the anomalous displacement of the perihelion planets of the solar system, it is known that their angular values decrease as 1/r, and the linear anomalous displacement S is a constant that is the same for all planets. The fact that this is confirmed in formula (4) is the justification for choosing the function $\alpha(r)$ in the form (1). From this formula (4) it clearly follows that the anomalous displacement of the perihelion of the planets depends only on the rotation of the star, the faster the star rotates, the greater the anomalous displacement of the perihelion of the planets.

3 Torsion coefficient

The formula for calculating the angle of displacement of the perihelion of the planets of the solar system for 1 revolution in an orbit with an eccentricity e and a large semi-axis a has the form:

$$\phi = \frac{S}{a(1 - e^2}; (5)$$

The angles of displacement of the perihelion of Mercury and other planets calculated using this formula are 25 % higher than the observational data. This means that the assumption that the Sun completely twists the surrounding space during rotation does not correspond to reality. It should be taken into account that physical space permeates material bodies, including the Sun through and through, and the surface of the Sun is not a special boundary for physical space to ensure a rigid attachment to it. Therefore, in formula (4) for the linear displacement of the perihelion, it is necessary to enter the coefficient of entrainment q, which varies in the range from 0 to 1.

$$S = 2\pi^2 q \omega r_s; (6)$$

If we use the well-known Einstein-Gerber formula for the linear displacement of perihelion in the form:

$$S = \frac{6\pi GM}{c^2}; (7)$$

then from (6) and (7) it is possible to obtain, independent of the observational data, an expression for calculating the torsion coefficient:

$$q = \frac{3GM}{c^2 \pi \omega r_s}; (8)$$

The use of formula (7) to determine the torsion coefficient requires a separate explanation. In contrast to formula (6), obtained under the assumption of torsion of physical space by a rotating star, either the relativistic effect (Einstein) or the delay of gravitational action (Gerber) is given to justify formula (7). But in all cases, changes in geometric parameters (angles, distances) and times are taken into account, which may be interrelated, since the results of calculations using these formulas coincide. Thus, on the one hand, the torsion of physical space by a rotating star is a justification for the displacement of the perihelion planets, and on the other hand, the displacement of the perihelion planets allows us to determine the torsion coefficient of physical space. For the Sun, according to the formula (8), the torsion coefficient of physical space q = 3/4. But if we calculate the torsion coefficient of physical space for the Earth, we get q = 0.00001, that is, the Earth does not twist physical space. This is confirmed by the coincidence of the calculated anomalous displacement of the Moon's perihelion with the observed value of 0.06". From formula (8) it follows that the greater the mass of the body M, the greater the torsion coefficient, and the faster the body rotates, i.e. the greater the ω, the lower the torsion coefficient, that is, physical space does not keep up with the rapidly rotating star.

4 The torsion of space and the Schwarzschild radius

The presence of the speed of light in formulas (7) and (8) creates the illusion of the influence of high-speed processes on the movement of planets, such as the speed of light or the speed of gravity propagation. If this were indeed the case, then the perihelion of the planets would lag behind in their orbital motion due to the lag of gravitational action. But if we rewrite these formulas using the expression for the Schwarzschild radius, they are significantly simplified and shed light not only on the displacement of the perihelion planets, but also on the processes occurring on the surface of black holes. Using the

Schwarzschild gravitational radius formula, i.e. the radius of a black hole with mass M:

$$r_g = 2GM/c^2; (9)$$

the formula (7) of the anomalous linear displacement of the perihelion per 1 revolution can be rewritten as:

$$S = 3\pi r_g;$$

Then the angular anomalous displacement ϕ, at zero eccentricity e, is calculated by the formula:

$$\phi = 3\pi r_g/r; (10)$$

It follows from this formula that for a black hole with a Schwarzschild radius $r = r_g$, the angular displacement of material objects near its surface is 3π, that is, the angular velocity of rotation of these objects is 2.5 times greater than the rotation velocity of the black hole itself. Taking into account (9), the formula for the torsion coefficient of space by a black hole can be rewritten as;

$$q = \frac{3}{2\pi\omega}; (11)$$

Thus, the torsion coefficient of space by a black hole depends only on its angular velocity. But the torsion coefficient cannot be greater than one, otherwise the space in its rotation would be ahead of the angular velocity of the object that rotates it. From this limitation, we get that a black hole cannot rotate slower than $3/2\pi(1/sec)$ or 4,6 revolutions per minute. This unexpected result may also be a limitation on the minimum size of a black hole and requires confirmation or refutation by observational data. It was previously noted that the total torsion of space (q = 1) by a rotating object means that there is a rigid connection between the surface of the object and the physical space. This, in particular, may mean that the surface of slowly rotating black holes is not permeable to physical space or there is no physical space inside them, and if there is, then it has nothing to do with the physical space outside.

5 Properties of gravity of a rotating star

The boundary conditions for the function $\alpha(r)$ coincide with the boundary conditions for the tangent to the tangential velocity of physical space. Integrating this function and considering that the torsion velocity of space on the surface of the star is known, we obtain the following expression for $U(r)$ in a rotating coordinate system (Fig.1):

$$U(r) = \omega(r - r_s(1 + \ln(r/r_s)));$$

and in a fixed coordinate system (Fig. 2):

$$U(r) = \omega r_s(1 + \ln(r/r_s));$$

The graph of the $U(r)$ function, on the one hand, is the rotation curves of physical space, and on the other hand, it is the lines indicating at any point in space the direction of the gravitational force of the star. This is the direction for a rotating star, different from the direction to its center of mass. The projection of the gravitational force in this direction is calculated according to the law of universal gravitation. It follows from formula (3) that the gravitational force$F = Fr/\cos\alpha(r)$ is always greater than the Fr calculated according to the law of universal gravitation. Since the gravitational force of the star is directed tangentially to the function $U(r)$, this function is the generative for the gravitational force and indicates its direction with the maximum value. Therefore, the graph of the function $U(r)$ is the line of action of the star's gravity, that is, gravity from the star does not propagate along straight lines passing through its center, but along the forming $U(r)$. Returning to the example with a thrown stone, it should be noted that the graph of the function $U(r)$ is the trajectory of the free fall of the stone downward, and its mirror image with respect to the axis r is the flight path of the stone launched vertically upward. Thus, for the Sun in both cases, the maximum deviation from the direction to the center is$\omega = 0.42$j. Thus, if the photon flies past the Sun, then it is deflected by Newton's Law of Universal Gravitation by 0.88 angular seconds toward the Sun, regardless of the direction of rotation. But under the influence of the Sun's rotation it is deflected by 2*0,42 =0,84“ on one side and by an angle of 0,84” on the other side. Total if the Sun rotates from left to right, then on the right the angle of deviation is 1.72“, and on the left 0.04”. According to the theory of relativity the angle of deviation of light is twice as much as according to Newton's Law of Universal Gravitation and is 1.75” regardless of the direction of rotation of the Sun.

6 Conclusion

Based on the hypothesis of the torsion of space by a rotating star, a new formula has been derived for calculating the linear displacement of the perihelions in one revolution. It has been established that this displacement is not anomalous and depends only on the radius and angular velocity of the star's rotation. And it does not depend on the gravitational constant, the speed of light and mass, as is the case in the famous Einstein-Gerber formula. The influence of rotation of a massive material object on physical space and the direction of gravity forces is considered. It is established that in this case, not the geometric parameters of space-time change, as is customary in the theory of relativity, but physical space rotates, that is, space changes in time. The variants of complete and incomplete torsion of space by rotating objects are considered. Based on the formulas for calculating the displacement of the perihelion of the planets of the solar system, the formula for the torsion coefficient of physical space q is derived. Numerical values of the torsion coefficient for the Sun (q=3/4) and for the Earth (q=0.00001) have been obtained, which are confirmed by observational data on the displacement of the perihelions of the planets and the Moon. Using formulas for the gravitational Schwarzschild radius, the problem of space torsion by a black hole is considered. It is established that the angle of displacement of the perihelion of a black hole satellite can reach a value of 3π per revolution, that is, its angular velocity, taking into account the displacement, will increase by 2.5 times, provided that the space on the surface of the black hole rotates with it, a limit on the minimum rotation speed of the black hole is 20 revolutions per minute. Based on the analysis of observational data on the displacement of the perihelion of the planets of the solar system, an analytical expression $U(r)$ of the torsion function of physical space is obtained. It follows from the type of function $U(r)$ that it depends only on the radius and speed of rotation of the star and does not depend on the mass and magnitude of the gravitational force. It is established that the graph of the function $U(r)$ is a guide for the gravitational force and has a physical meaning of the trajectory of free fall and free take-off, and the angle of deviation of the gravitational force depends on the direction of rotation, and the maximum value of the angle of deviation of the light ray when passing near the Sun agrees with observations during solar eclipses.

7 References

1. Albert Einstein Collection of scientific papers in four volumes. Nauka, 1966, volume II, pp. 83-94.
2. Ginzburg V.L. "Experimental verification of the theory of relativity", UFN, May 1956, vol. LIX, issue I, pp. 11-49