

New Explanation of Advance of Planetary Perihelion and Solar System's Vortex Motion

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Abstract: Although the explanation of general relativity for the advance of planetary perihelion is reasonably consistent with the observed data, because its orbit is not closed, whether or not it is consistent with the law of conservation of energy has not been verified. For this reason a new explanation is presented: The advance of planetary perihelion is the combined result of two motions. The first elliptical motion creates the perihelion, and the second vortex motion creates the advance of perihelion. In the motion of planet-sun system, under the action of gravity, the planetary orbit is a closed ellipse, and consistent with the law of conservation of energy. Meanwhile, the planet also participates in the vortex motion of solar system taking the sun as center; the long-term trend of the vortex is the further topic, but in the short-term may be considered that due to the inertia the planetary perihelion will run circular motion in vortex and lead to the advance of perihelion, thus also without acting against the law of conservation of energy. Based on the result of general relativity, the approximate angular velocity of advance of perihelion is given; based on accurate astronomical observation, the accurate angular velocity is given. Finally the approximate expression for circular velocity of solar system's vortex motion is presented. For ordinary vortex motion the circular velocity is inversely proportional to the radius r , but for solar system's vortex motion, it is inversely proportional to $r^{3/2}$.

Key words: Advance of planetary perihelion, new explanation, general relativity, angular velocity of advance, solar system's vortex motion

Introduction

Many scholars believe that general relativity does not end the studying for problem of advance of planetary perihelion, because there are many factors affecting the advance of planetary perihelion, it still needs to continue to study this issue. This paper presents a new explanation: The advance of planetary perihelion is the combined result of two motions. The first elliptical motion creates the perihelion, and the second vortex motion creates the advance of perihelion. Finally the approximate expression for circular velocity of solar system's vortex motion is presented. For ordinary vortex motion the circular velocity is inversely proportional to the radius r , but for solar system's vortex motion, it is inversely proportional to $r^{3/2}$.

1 Result of general relativity

According to general relativity, the value of advance of planetary perihelion reads ^[1]

$$\varepsilon = \frac{24\pi^3 a^2}{T^2 c^2 (1-e^2)} \quad (1)$$

where: c is the speed of light; T , a , and e are orbital period, semi-major axis and eccentricity respectively.

Although the explanation of general relativity for the advance of planetary perihelion is reasonably consistent with the observed data, because its orbit is not closed, whether or not it is consistent with the law of conservation of energy has not been verified. In fact, this verification is very difficult, so for many years it has been left without anybody to care for.

2 New explanation of combined motion

According to this new explanation, the advance of planetary perihelion is the combined result of two motions. The first elliptical motion creates the perihelion, and the second vortex motion creates the advance of perihelion.

In the first motion of planet-sun system, under the action of gravity, due to $F = GMm/r^2$, and without considering other factors such as the perturbation of other planets, the planetary orbit is a closed ellipse, and consistent with the law of conservation of energy.

Meanwhile, the planet also participates in the vortex motion of solar system taking the sun as center; the long-term trend of the vortex is the further topic, and we will not discuss it in this paper; but in the short-term may be considered that due to the inertia the planetary perihelion will run circular motion in vortex and lead to the advance of perihelion, thus also without acting against the law of conservation of energy.

In a word, the proposed new explanation of combined motion does not run counter to the law of conservation of energy from start to finish.

3 Angular velocity of advance of perihelion

According to Eq.(1), taking the sun as center, the angular velocity of advance of planetary perihelion is as follows

$$\omega = \frac{\varepsilon}{T} = \frac{24\pi^3 a^2}{T^3 c^2 (1-e^2)} \quad (2)$$

According to Kepler's third law, it gives

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

where: G is the gravitational constant, and M is the solar mass.

Then Eq. (2) can be rewritten as

$$\omega = \frac{3G^{3/2}M^{3/2}}{a^{5/2}c^2(1-e^2)} \quad (3)$$

According to this expression we can see that, the angular velocity of advance of planetary perihelion is inversely proportional to $a^{5/2}$, and the velocity of advance of planetary perihelion is inversely proportional to $a^{3/2}$.

For the results of Eq.(1), there are small differences compared with accurate astronomical observations, so we say that results of Eq.(2) and Eq.(3) are the approximate angular velocities of advance of perihelion based on the related results of general relativity.

If based on accurate astronomical observation, we can reach the accurate angular velocity of advance of perihelion as follows.

$$\omega' = \frac{\varepsilon'}{T}$$

where: ε' is the accurate astronomical observation of advance of perihelion.

Now the rotate transformation in Cartesian coordinate system is applied to derive the planetary orbit equation including the advance of perihelion.

In the planet-sun system, taking the solar center as the origin of coordinate, the planetary orbit equation reads

$$\frac{(x-k)^2}{a^2} + \frac{y^2}{b^2} = 1$$

where: k is the semi-focal length of ellipse.

According to the rotate transformation in Cartesian coordinate system, it gives

$$x = x' \cos \theta - y' \sin \theta$$

$$y = x' \sin \theta + y' \cos \theta$$

where: θ is the angle of rotation (namely the angle of advance), $\theta = \omega t$ or $\theta = \omega' t$.

Thus, after considering the vortex motion, the planetary rotation orbit equation is as follows

$$\frac{(x' \cos \theta - y' \sin \theta - k)^2}{a^2} + \frac{(x' \sin \theta + y' \cos \theta)^2}{b^2} = 1$$

4 The circular velocity of solar system's vortex motion

We already pointed out that, the reason for the advance of planetary perihelion is the vortex motion taking the sun as center. Now we discuss the circular velocity of this vortex motion at the position of radius r .

Assuming that the angular velocity of solar system's vortex motion is approximately equal to the angular velocity of advance of planetary perihelion, and in Eq.(3) the value of a is replaced by the radius r , moreover the eccentricity e is omitted, then apply the formula $v = r\omega$, it gives the circular velocity of this vortex motion at the position of radius r as follows

$$v \approx \frac{3G^{3/2}M^{3/2}}{r^{3/2}c^2} \quad (4)$$

From this expression we can see that, unlike the ordinary vortex motion (its circular velocity is inversely proportional to the radius r), for solar system's vortex motion, the circular velocity is inversely proportional to $r^{3/2}$.

Reference

- 1 A. Einstein, Sitzungsber. Preuss.. Akad. Wiss. 1915, No.47, 831-839