American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-9, Issue-11, pp-65-70
www.ajer.org
Research Paper Open Access

Proposal of Verification Experiment in Outer Space: Phenomenon of Anomalous Weight Reduction on A Gyroscope's Right Rotations

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ABSTRACT :*It was found that the clockwise spinning of a gyro (made from non-magnetic materials) around the vertical axis causes weight decrease in 1989 [1]. Repeated tests of this experiment were conducted many times in each country, but negative results were reported with positive results. Since the measurement value of weight reduction is relatively small, it is certain that verification is difficult due to the measurement system and experimental accuracy. Above-stated experiments including additional tests were conducted on the Earth. This paper proposes to conduct the experiment in different method in outer space: attempt to verify the gyro fall experiment on the Earth by conducting clockwise and counterclockwise rotation experiments of the gyro in flat outer space without gravity.*

KEYWORDS *gravity, General Relativity, weight reduction, right rotation, space-time, acceleration field, de Rham cohomology effect.*

Date of Submission: 28-10-2020 Date of acceptance: 09-11-2020

I. INTRODUCTION

It was found that the clockwise spinning of a gyro (made from non-magnetic materials) around the vertical axis causes weight decrease (Hayasaka, Takeuchi, 1989) entitled "Anomalous weight reduction on a gyroscope's right rotations around the vertical axis on the Earth" [1].

The outline is as follows: Each weight change of three spinning mechanical gyroscopes whose rotor's masses are 140, 175, and 176 g has been measured in inertial rotations without systematic errors. The experiments show that the weight changes on rotations around the vertical axis are completely asymmetrical. The right rotations (viewing from the above) cause weight decrease of the order of milligrams (weight), proportional to the frequency of rotations at 3 000–13 000 rpm. However, the left rotations do not cause any change in weight.

Subsequently, it was found that the clockwise spinning of a gyro fall-time increase (Hayasaka, Tanaka, Hasida, Chubachi, Sugiyama 1997)[2], [3].

It seems that both rotations cause the different gravitational fields due to the topological effect. This means that the connection coefficient on both rotations is not symmetrical ($\Gamma^{\mu}_{\nu\sigma} \neq \Gamma^{\mu}_{\sigma\nu}$), and then the fields are torsion like or twisted.

Repeated tests of this experiment were conducted many times in each country, but negative results were reported with positive results. Since the value of weight reduction is relatively small, it is certain that verification is difficult due to the measurement system and experimental accuracy.

After that, Hayasaka and Minami introduced the concept of a new device using magnetic fluid entitled "REPULSIVE FORCE GENERATION DUE TO TOPOLOGICAL EFFECT OF CIRCULATING MAGNETIC FLUIDS" at NASA STAIF 99 congress [4]. This is intended for the application to space propulsion systems.

The gravitational acceleration decrease on the clockwise spinning is proportional to the product of a coefficient $\theta(=7\times10^{-14}m^{-1})$, velocity of light c, and rotational velocity $r\omega$, where r is rotational radius, and ω is angular frequency (angular velocity). This is due to the generation of torsion field on the de Rham cohomology effect of four-dimensional angular momentum of a rotational object (see APPENDIX).

Since then, the experiment has been vigorously continued by Nuno Santos of Portugal (Oporto University). The results are shown in the article entitled "Gravity control with help of de Rham cohomology" [5].

Above-stated Experiments including additional tests are being conducted on the Earth. In the fall experiment on the Earth, it is necessary to consider the influence of the tidal force of the gravitational acceleration, the influence of the Coriolis force, the influence of the temperature and pressure fluctuation, the influence of the surrounding vibration noise, etc., as to the measurement change in the weight of the gyro or in the fall time.

Furthermore, in the gyro drop experiment, it is necessary to consider the friction at the time of releasing the gyro wire and the influence of the release mechanism.

Negative conclusions from previous gyro drop experiments may be related to the accuracy of the test system being conducted, in addition to the relatively small measurement values of gyro weight changes or gyro fall time changes.

This paper proposes to conduct the experiment in different method in outer space.

II. VERIFICATION EXPERIMENT IN OUTER SPACE

Since weight reduction is essentially caused by gravitational acceleration, the fact that it becomes lighter with clockwise rotation indicates that acceleration opposite to gravitational acceleration ($9.8 m/s^2$) is generated by clockwise rotation (viewing from the above). Ignoring the direction of acceleration, the clockwise rotation of the gyro creates an acceleration field in the space around the gyro, and the left rotation does not generate an acceleration field.

The outline of the proposed experiment is as follows.

As shown in Fig.1, a total of three objects, a high-speed clockwise (CW) object blue and a high-speed counterclockwise (CCW) object red and zero-rotation object, are left in outer space.

Specifically, two objects stationary in outer space are started to rotate clockwise and counterclockwise by wireless commands. The change in the position of three objects over a predetermined period is measured by laser ranging.

The gravitational repulsive acceleration $\alpha(R)$ due to the topological effect which is caused by only the clockwise rotation of a gyro constructed by non-magnetic materials is given by

$$\alpha(R) = \theta c r\omega = 7\times10^{-14}\times c r\omega = 2\times10^{-5} r\omega \quad (m/s^2) \quad . \qquad (1)$$

The gravitational acceleration decrease on the clockwise spinning is proportional to the product of a coefficient $\theta (= 7\times10^{-14} m^{-1})$, velocity of light c, and rotational velocity $r\omega$, where r is rotational radius, and ω is angular frequency (angular velocity) [1].

The change in the position of the object depends on the time t. The change in position, that is, the moving distance of the object (S) due to acceleration (α), is measured during laser irradiation time (t): $S = 1/2 \cdot \alpha t^2$.

All that time, the positions of the three objects will change. Verify whether a clockwise (CW) rotating object can be detected its movement with respect to a counterclockwise (CCW) rotating object and a non-rotating object.

It is possible to use the space station (ISS: International Space Station) and carry it out in the exposed part of the space station or in outer space near it, or put it into geosynchronous orbit and observe the position change by laser irradiation from the Earth. However, it should be carried out after taking measures such as removing disturbances that do not affect the measurement system.

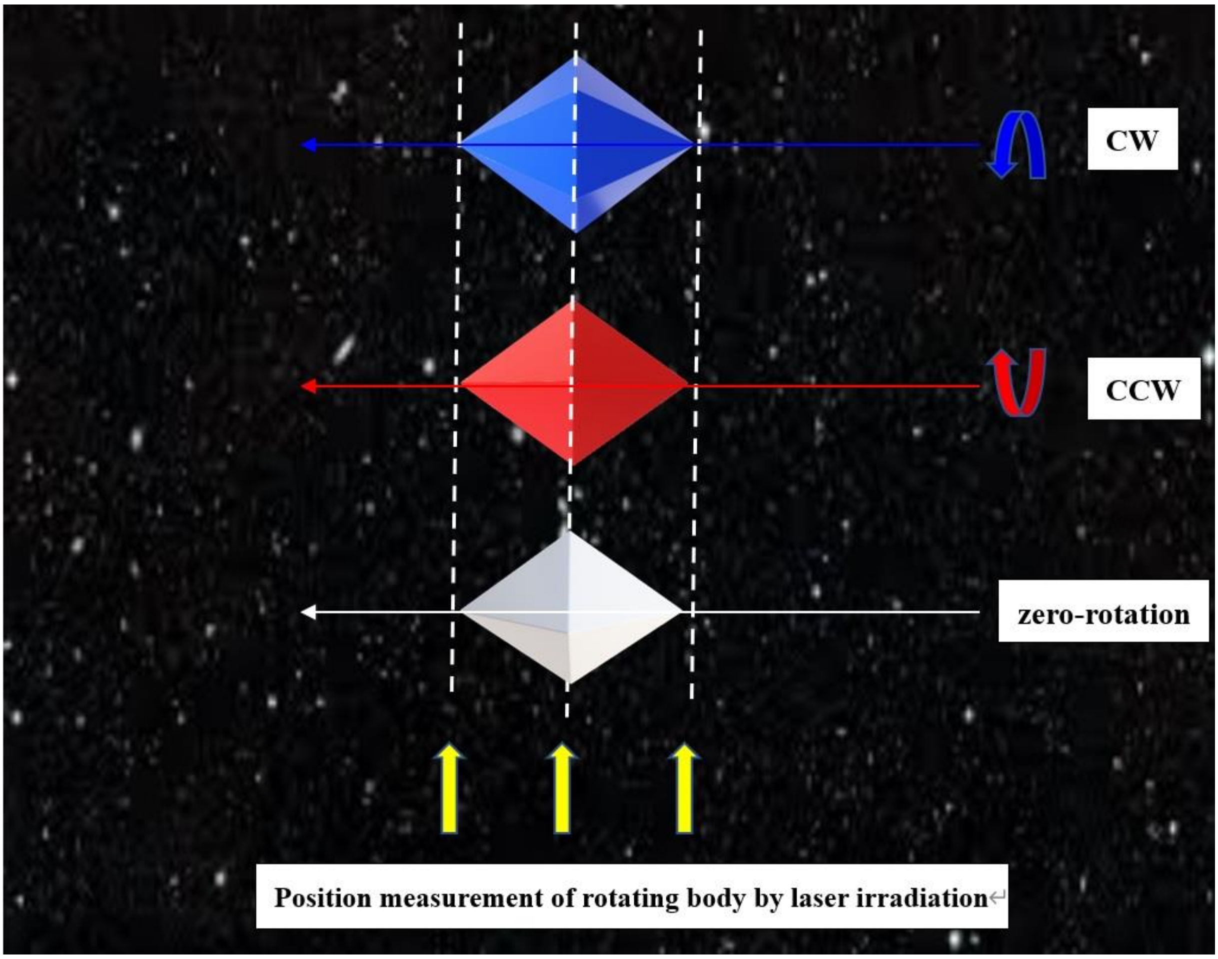

Fig. 1. Outline of the experiment

<Trial calculation>
Here, let us trial calculate using Eq. (1):

N=3000rpm, then, from $\omega = \frac{2\pi N}{60}(rad/s)$, ω=314rad/s, r=1m.

$$\alpha(R) = 2\times10^{-5}\times1\times314 = 628\times10^{-5}(m/s^2)$$

t=1000s, then, $S = \frac{1}{2}\times628\times10^{-5}\times1000^2 = 3140m$.

Sufficient position change can be measured by appropriately adjusting the laser irradiation time and the rotation speed of the object.

III. CONSIDERATION

Apply Kerr metric because it is a rotation of a rotating body like a gyro.

Kerr Rotating Mass Solution

The metrics outside of spinning mass are given by:

$$g_{00} = -\left(1 - \frac{r_g r}{r^2 + h^2\cos^2\theta}\right), \quad g_{33} = \frac{r^2 + h^2\cos^2\theta}{r^2 - r_g r + h^2}, \qquad (2)$$

where $h = J/Mc \quad (J = angular\ \ momentum)$, $r_g = 2GM/c^2$.

Eq.(2) reduces to the Schwarzschild solution if the angular momentum "*J*" is zero.

On the while, the acceleration (α) of curved space and its Riemannian connection coefficient (Γ^3_{00}) are given by:

$$\alpha = \sqrt{-g_{00}}\,c^2\Gamma^3_{00} \ , \qquad \Gamma^3_{00} = \frac{-g_{00,3}}{2g_{33}} \tag{3}$$

where c=speed of light, g_{00} and g_{33}=component of metric tensor, $g_{00,3} = \partial g_{00}/\partial x^3 = \partial g_{00}/\partial r$.

We choose the spherical coordinates " $ct=x^0$, $r=x^3$, $\theta=x^1$, $\varphi=x^2$ " in space-time.

Combining Eq.(3) with Eq.(2) yields:

$$\alpha = G\cdot\frac{M}{r^2}\cdot\frac{(1-h^2\cos^2\theta/r^2)}{(1+h^2\cos^2\theta/r^2)^3} < G\cdot\frac{M}{r^2} \ , \ (r_g < r). \tag{4}$$

Eq.(4) indicates that the rotation weakens the gravitational acceleration.

Regardless of the direction of rotation, whether the rotation is clockwise or counterclockwise, the field of acceleration in the space near the rotating body decreases as compared to the field of acceleration in the space near the stationary state object. This means that the connection coefficient on both rotations is symmetrical ($\Gamma^{\mu}_{\nu\sigma} = \Gamma^{\mu}_{\sigma\nu}$).

According to this experiment, only in the case of clockwise rotation, if it is verified that an acceleration field is generated in the space near the rotating body, it will become asymmetrical as shown below and a new research field will be opened. Because it means that the connection coefficient on both rotations is not symmetrical ($\Gamma^{\mu}_{\nu\sigma} \neq \Gamma^{\mu}_{\sigma\nu}$), and then the fields are torsion like or twisted.

By the way, a massive body causes the curvature of space-time around it, and a free particle responds by moving along a geodesic line in that space-time. The path of free particle is a geodesic line in space-time and is given by the following geodesic equation:

$$\frac{d^2x^i}{d\tau^2} + \Gamma^i_{jk}\cdot\frac{dx^j}{d\tau}\cdot\frac{dx^k}{d\tau} = 0, \tag{5}$$

where $\Gamma^i{}_{jk}$ is Riemannian connection coefficient, τ is proper time, x^i is four-dimensional Riemann space, that is, three dimensional space ($x=x^1$, $y=x^2$, $z=x^3$) and one dimensional time ($w=ct=x^0$), c is the velocity of light. These four coordinate axes are denoted as x^i (i=0, 1, 2, 3).

From Eq.(5), the acceleration of free particle is obtained by

$$\alpha^i = \frac{d^2x^i}{d\tau^2} = -\Gamma^i_{jk}\cdot\frac{dx^j}{d\tau}\cdot\frac{dx^k}{d\tau} \ . \tag{6}$$

As is well known in General Relativity, in the curved space region, the massive body "*m* (kg)" existing in the acceleration field is subjected to the following force F^i(N) :

$$F^i = m\Gamma^i_{jk}\cdot\frac{dx^j}{d\tau}\cdot\frac{dx^k}{d\tau} = m\sqrt{-g_{00}}\,c^2\Gamma^i_{jk}u^ju^k = m\alpha^i, \tag{7}$$

where u^j,u^k are the four velocity, $\Gamma^i{}_{jk}$ is the Riemannian connection coefficient, and τ is the proper time.

From Eqs.(6),(7), we obtain [6]:

$$\alpha^i = \frac{d^2x^i}{d\tau^2} = -\Gamma^i_{jk}\cdot\frac{dx^j}{d\tau}\cdot\frac{dx^k}{d\tau} = -\sqrt{-g_{00}}\,c^2\Gamma^i{}_{jk}u^ju^k \ . \tag{8}$$

If in the case of $\Gamma^i_{jk} \neq \Gamma^i_{kj}$, the acceleration α^i differs. Namely, it means that there occurs a difference in the acceleration field around the gyro between clockwise and counterclockwise rotation of the gyro.

IV. CONCLUSION

Even if the acceleration generation due to the clockwise rotation of the gyro is small value, a measurable movement distance can be achieved by accelerating in a sufficient time.

It will be possible to eliminate the indistinguishable defect between the minute measurement value of the gyro drop experiment on the Earth and the noise of the test system.

Therefore, the significance of this experiment is considered to be important.

APPENDIX: GRAVITATIONAL REPULSIVE FORCE DUE TO THE de Rham COHOMOLOGICAL EFFECT ON 4-DIMENSIONAL ANGULAR MOMENTUM OF AN OBJECT'S CLOCKWISE SPINNING

It was anticipated that the gravitational force caused by an object's clockwise rotation in viewing from the above is different from that of the counter-clockwise rotation from the de Rham cohomology second theorem, and that the clockwise rotation causes gravitational repulsive force due to torsion field (Hayasaka, 1994)[7]. According to the de Rham cohomology theorem (de Rham, 1960), if the integrals of two quantities Ω and Ω' are equal along a closed path C, there is a difference provided by an exact differential dχ between Ω and Ω', that is,

$$if \ \oint_C (\Omega - \Omega') = 0, \quad then \ \ \Omega - \Omega' = d\chi \neq 0 \ . \tag{A1}$$

To discuss the above-mentioned theorem for the concrete application, let us consider a rotor which is constrained on a horizontal plane, and is spinning in a stationary state around the vertical axis. The rotor is regarded as only a dust ensemble consisting of many mass points, so that the problem of the stationary spinning motions of the rotor is reduced to the problem of the stationary rotations of a mass point along a circle. The calculations of the gravitational forces associated with both rotational motions are carried out in an approximately flat space-time where the Cartesian coordinates are set by x^0, x^1, x^2 and x^3 (ct, x, y and z). In the case of a closed system, the 4-dimentional angular momentum $M^{\mu\nu}$ is given by

$$M^{\mu\nu} = \frac{1}{c}\int (x^\mu f^\nu - x^\nu f^\mu) dx^0 \ . \tag{A2}$$

If the theorem is applied to the conserved 4-dimensional angular momentum M^{03} or M^{30} of a rotating object, there is certain difference between the gravitational forces on the clockwise and the counterclockwise rotations, as follows. We are now concerned with x^3 component of gravitational force f^μ or f^ν. Therefore, only the component of angular momentum M^{03} or M^{30} of a rotating object given by the following will be considered,

$$M^{03}(L) = \frac{1}{c}\int \{x^0 f^3(L) - x^3 f^0(L)\} dx^0 = \frac{1}{c}\int \{x^0 f^3(R) - x^3 f^0(R)\} dx^0 = M^{03}(R) \ . \tag{A3}$$

From Eq.(A3), taking the invariance of M^{03} or M^{30} on the mirror transformation into account, we get

$$M^{03}(L) - M^{03}(R) = 0, \quad then \quad \frac{1}{c}\oint_C [x^0\{f^3(L) - f^3(R)\} - x^3\{f^0(L) - f^0(R)\}] dx^0 = 0, \tag{A4}$$

where the C on integral denotes a closed path in the base space.
Applying Eq.(A1) to Eq.(A4), we get

$$\frac{1}{c}[x^0\{f^3(L) - f^3(R)\} - x^3\{f^0(L) - f^0(R)\}] dx^0 = d\chi \neq 0 \ . \tag{A5}$$

Therefore, the conservation of $M^{03}(L)$ on the counterclockwise rotation and $M^{03}(R)$ on the clockwise rotation leads to the following representation

$$\frac{1}{c}\oint_C \{x^0 f^3(L) - x^3 f^0(L)\} dx^0 - \frac{1}{c}\oint_C \{x^0 f^3(R) - x^3 f^0(R)\} dx^0 = \oint_C d\chi \ . \tag{A6}$$

Since arbitrary function χ is given generally by Fourier expansion, dχ is satisfied by the following periodic function

$$d\chi = \{-\sum_N A_N N \overset{*}{\omega} \sin N \overset{*}{\omega} x^0 + \sum_N B_N N \overset{*}{\omega} \cos N \overset{*}{\omega} x^0\} dx^0 \ . \tag{A7}$$

From Eqs.(A5),(A6) and (A7), we obtain

$$f^3(L) - f^3(R) = -\frac{c\sum_N A_N N \overset{*}{\omega} \sin N \overset{*}{\omega} x^0}{x^0} \ . \tag{A8}$$

The second term on Eq.(A7), i.e. $B_N N \overset{*}{\omega} \cos N \overset{*}{\omega} x^0 / x^0$ is not be accepted because of its divergence to infinity for $x_0 \rightarrow 0$. Applying the de Rham cohomology theorem to 4-dimensional angular momentum, it is no longer $f^3(L)=f^3(R)$, and there exists a finite difference. Since each term of the right hand side on Eq.(A8) represents a sampling function or Dirac's δ function for N»1, the right hand side is equal to the sum of pulse functions with respect to time x^0 . This means that an object rotating along a closed path C causes the excitation of the vacuum in atom. In the other words, both rotations cause the different gravitational fields due to the topological effect. It means that the connection coefficient on both rotations is not symmetrical ($\Gamma^{\mu}_{\nu\sigma} \neq \Gamma^{\mu}_{\sigma\nu}$), and then the fields are torsion like or twisted. From the analogy with β-decay (i.e., weak interaction) in which the clockwise circulating electrons in a coil generating external magnetic field and the emitted electrons from nucleus form the left-handedness, the gravitational repulsive acceleration α(R) due to the topological effect which is caused by only the clockwise rotation of a gyro constructed by non-magnetic materials is given by

$$\alpha(R) = \theta c r \omega = 7\times10^{-14}\times c r \omega = 2\times10^{-5} r \omega \quad (m/s^2) \quad . \qquad \text{(A9)}$$

Equation (A9) has been confirmed by both experiments of weight change and fall-time measurements.

ACKNOWLEDGMENTS

The author acknowledges Prof. H. Hayasaka of Tohoku University for his previous useful discussions.

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Yoshinari Minami. "Proposal of Verification Experiment in Outer Space: Phenomenon of Anomalous Weight Reduction on A Gyroscope's Right Rotations." *American Journal of Engineering Research (AJER)*, vol. 9(11), 2020, pp. 65-70.