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RESEARCH ARTICLE

Gravitational Induction

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Abstract

This article examines the concept of gravitational induction as an analogue of electromagnetic induction. It briefly describes results of experiments which show the expediency of using gravitational induction in the phenomenological description of non-classical properties of gravity.

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Keywords: Gravitation, Weight, Acceleration, Induction.

1. Introduction

The phenomenon of electromagnetic induction, discovered in the XIX century by Faraday and Henry, has been well studied. When flow of the magnetic field vector changes through a surface limited by a closed conductor (contour), an electric current occurs in the conductor, creating a magnetic field that compensates for changes in the initial magnetic flow. This phenomenon reflects the general tendency of thermodynamically equilibrium physical systems to maintain a stable state. The property of inertia of a physical system is consistent with the third law of dynamics - the equality of forces of action and reaction; and finds expression in a variety of other patterns: in the optics of inhomogeneous environments - in the movement of a light beam in the area of an increased refractive index, in chemical reactions - Le Chatelier – Brown principle - and others. The tendency of a phys-chemical system to maintain a stable state takes peculiar forms in the physics of gravitation (gravity). Similarly to the phenomena of electromagnetic induction, the corresponding regularities in the phenomenological description of gravity based on experience can be briefly characterized by the term "gravitational induction".

2. Gravitational Induction

The phenomenon of gravitational induction is explained in Fig.1.

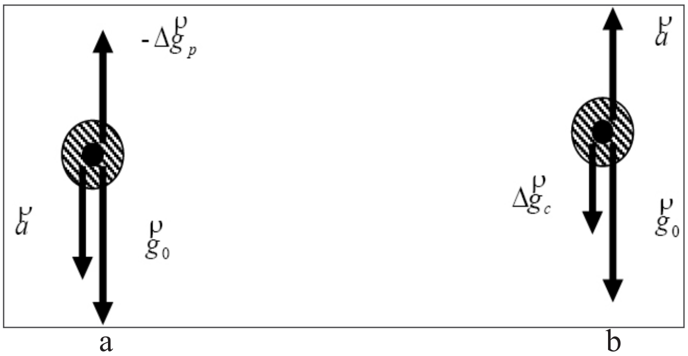

Figure 1. *Gravitational induction.*

a – the ball moves downward under the influence of an external force with acceleration a, the induced change in the acceleration of gravity applied to the ball is negative and equal to Δg_p . b – the ball moves upwards under the influence of an external force with acceleration a, the change in acceleration of gravity applied to the ball is positive and equal to Δg_c.

In a homogeneous gravitational field for a test ball stationary relative to the Earth, the acceleration of gravity g_0 is constant. If, under the influence of an external, for example, elastic force, the ball is accelerated upward, the induced acceleration increment of gravity affecting the ball, in the first approximation, is directly proportional to the magnitude of acceleration of the ball:

$$\Delta g_c = \alpha_c a \tag{1}$$

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When the test ball moves downwards accelerated, also under the action of an external force, the corresponding increment in the acceleration of gravity changes the sign and, generally speaking, the magnitude:

$$\Delta g_p = - \alpha_p a \quad . \qquad (2)$$

In (1, 2) dimensionless coefficients α_c and α_p characterize the degree of influence of external non-gravitational, for example, elastic (electromagnetic) forces on gravity [1].

The numerical values of the coefficient α_c can be estimated on the basis of measurements of the restitution coefficients for vertical (κ_1) and horizontal (κ_2) elastic impacts of the ball on the surface of the plate (Fig. 2, 3); here the acceleration experienced by the ball during the duration of elastic impacts reaches tens of thousands of normal gravity accelerations, which makes it possible to make practical estimates of the values of the coefficients α_c and α_c [2].

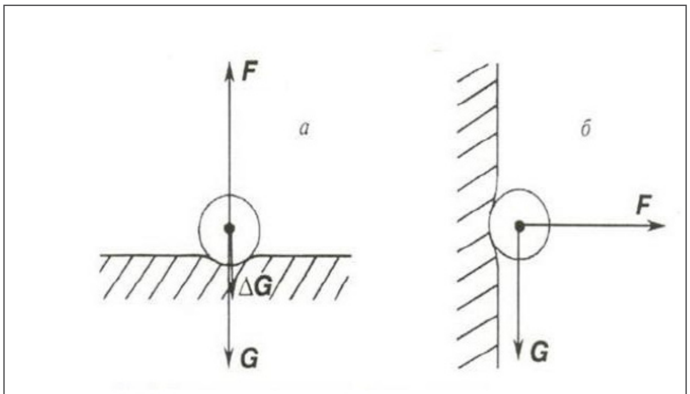

Figure 2. *Vertical (a) and horizontal (b) impacts of the ball.*

$F -$ the elastic force causing the ball to return is gravity. An example of the experimental dependences of the restitution coefficients on the velocity of the ball before impact is shown in Fig. 3.

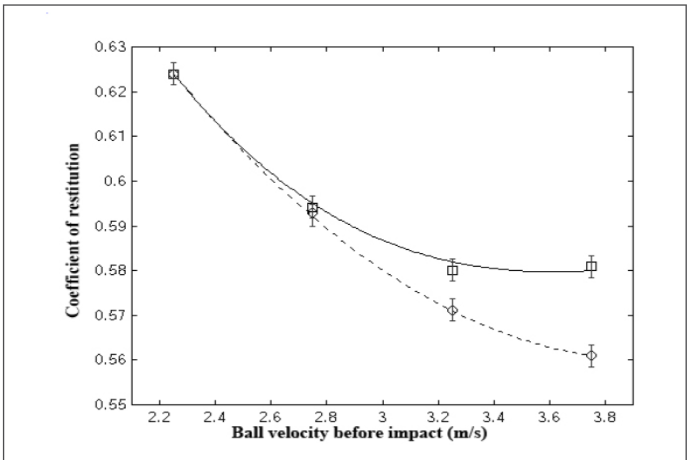

Figure 3. *Experimental dependency of the restitution coefficients on the velocity of the ball before impact with vertical (k1), dashed line, and horizontal (k2), solid line, quasi-elastic impacts of the ball on the plate.*

The coefficient α_c is equal to

$$\alpha_c \approx \frac{k_2 - k_1}{k_1}$$

According to the measurements shown in Figure 3, the calculated value of the coefficient $\alpha_c \approx 2 \cdot 10^{-2}$ In this case, the acceleration of the ball during the duration of the impact is equal to $3 \cdot 10^5 m/s^2$.

3. Weighing of the Rotor with a Horizontal Axis of Rotation

A simple way to estimate the difference in coefficients α_c and α_p is based on accurate weighing of the rotor of a mechanical gyroscope with a horizontally oriented axis of rotation. The rotational motion of the rotor is accompanied by centripetal accelerations of its constituent particles, while the role of extraneous non-gravitational forces impacting the rotor particles is played by elastic forces. Based on (1,2), by integrating increments Δg_c and Δg_p over the entire volume of the rotor, it can be shown that the weight P of a horizontally oriented rotor in the form of a solid cylinder with an internal radius R_1 and an external radius R_2 ,

$$P = mg_0 \left[1 - (\alpha_p - \alpha_c) \frac{2(R_2^3 - R_1^3)}{3\pi g_0 (R_2^2 - R_1^2)} \omega^2 \right]$$

where m the mass of the rotor and ω the angular velocity of its rotation.

Since the rotation of the body is represented by a superposition of two phase-shifted oscillations along orthogonal coordinate axes, it follows from (4) that the weight m averaged over the oscillation period of a mechanical oscillator, performing vertical oscillations with frequency ω and amplitude A under the action of an external elastic force, is equal to

$$P = mg_0 \left[1 - (\alpha_p - \alpha_c) \frac{A\omega^2}{\pi g_0} \right]$$

At the same time, horizontal oscillations of rotor particles do not influence its weight. The relative change in the weight of a vertically oscillating oscillator due to the effect of gravitational induction is equal to .

$$\frac{\Delta P}{P} = - (\alpha_p - \alpha_c) \frac{A\omega^2}{\pi g_0}$$

According to the weight measurements of paired aviation gyroscopes with zero total kinetic moment, the difference between the interaction coefficients α_p and α_c is equal to approximately 10^{-7} [2,3].

4. Experiments on Weighing Rotors with Horizontal Orientation of the Axis of Rotation.

The appearance of container No. 1 with the fixed rotor of a mechanical aviation gyroscope with a horizontal axis of rotation is shown in Figure 4. Technically, it is convenient to weigh the gyroscope in the run-out state, with the rotor power supply conductors disconnected, which eliminates the influence of additional mechanical loads on the container being weighed.

Figure 4. *Fixed rotor of a mechanical aviation gyroscope with a horizontal axis of rotation*

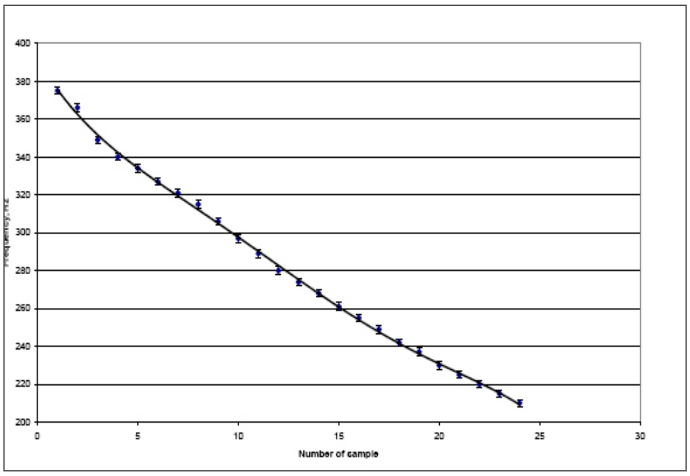

Figure 5. *Temporary dependency of the rotational speed of the rotor of an aviation gyroscope during a run-out lasting 25 minutes.*

Figure 6 shows the results of two consecutive series of weighing of a container with a running-out rotor fixed in it with a horizontally oriented axis of rotation. It is characterized by a significant reduction in the weight of the rotor in the first seconds of measurements, when its rotation speed is maximum. In subsequent moments of observation, changes in the weight of the rotor may have a more complex, periodic character, which is explained in the elementary theory of weighing a mechanical oscillator located in a variable gravity field [3].

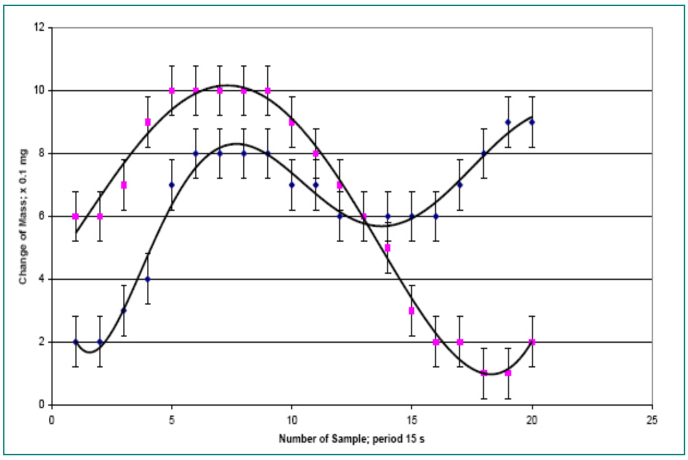

Figure 6. *Experimental temporary dependencies of the weight change of container No. 1 with the rotor of an aviation gyroscope fixed in it with a horizontal axis of rotation [6,7].*

Figure 7 shows the results of weighing container No. 2 with a brass rotor with a diameter of 52 mm and a mass of 290 g installed in it, before starting measurements by a compact electric motor driven into rotation. The container was weighed during the rotor run-out, while the maximum rotor speed in the first seconds of measurements was 85 Hz. As in Fig. 6, at the beginning of measurements, at the highest speed of rotation of the rotor, there is a decrease in the weight of the container, reaching 10 mg with a weighing error (discreteness of readings of the scales) 1 mg. In the experiments, the results of which are presented in Fig.6 and Fig.7, the influence of artifacts (electrical and magnetic interference, vibrations, air convection) in comparison with the dominant kinetic effect of weight loss is insignificant. Calculated, according to (5), reduction of the rotor weight at a speed of 80 Hz is about 4.6 mg.

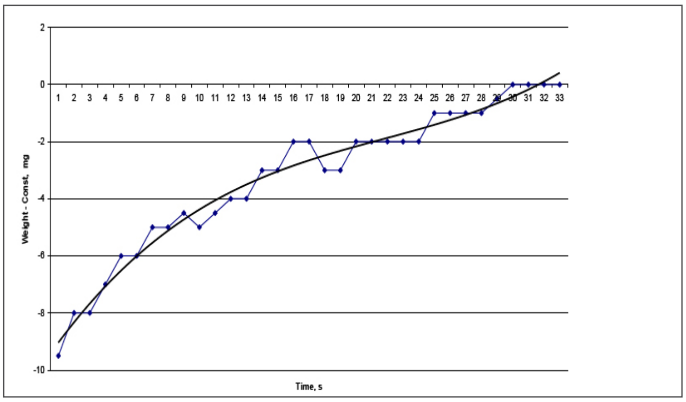

Figure 7. *Experimental temporary dependency of the weight change of container No. 2 [8].*

Measurements of the weight of "run-out" rotors with a horizontally oriented rotation axis, within the measurement errors, systematically demonstrate weight reduction, maximum at the highest frequency of rotation of the rotors. A detailed analysis of physical factors affecting changes in the weight of containers is an independent task.

5. The Temperature Dependency of the Physical Eight of Bodies

The consequence of the described phenomenon of gravitational induction and inequality the coefficients α_p and α_c is a relatively strong negative temperature dependency of the physical weight of bodies, confirmed by many laboratory experiments [2, 4-6]. In these experiments, high-precision weighing was conducted on non-magnetic metal rods which were heated by ultrasound or electric heaters. Similar results were obtained when using the chemical method of heating of weighed sample (Fig. 8, Fig. 9).

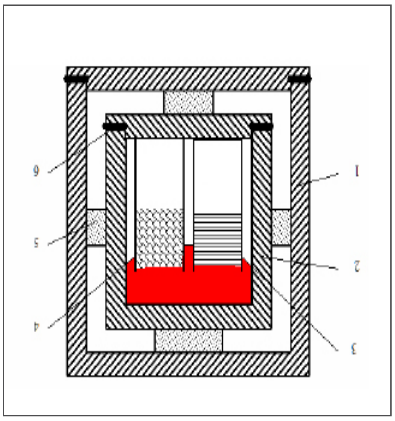

Figure 8. *A sealed container with chemical heating of a weighed sample.*

The inside of the container is heated when the crystals KOH are dissolved during a cuvette coup.

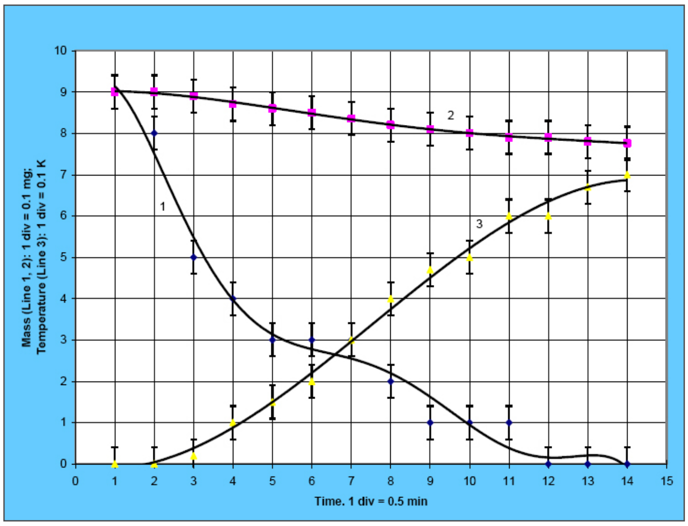

Figure 9. *An example of an experimental temporary dependency (1) of the weight of a chemically heated sample; (2) - a calculated change in the weight of the container due to a change in the temperature of the external cylinder of the container; (3) - a change in the surface temperature of the external cylinder.*

The described experiments took into account the influence of artifacts - a change in the buoyancy of the container due to its thermal expansion, electric and magnetic interference and temperature convection of the surrounding air sample. The negative temperature dependency of the weight of the bodies is confirmed by laboratory experiments.

The decrease in the physical weight of the heated bodies is due to accelerations of the body of microparticles during their thermal movement and is determined by the absolute temperature of the bodies, which reaches high values (thousands K) in a gas glow discharge. In [6] it is shown that with air pressure in a discharge chamber 0.1 atm., the correct accurate form of the channel of the glow discharge (Fig. 10) is explained by pushing the plasma in the gravitational field, the physical cause of which is the temperature dependency of the weight.

Figure 10. *The form of a glow discharge at a pressure of 0.1 atm.*

6. Gravitational Induction and the Principle of Mach.

Based on the principle of Mach, who claims that the inertial properties of bodies are due to their gravitational interaction with all those around him, including "infinitely remote", masses, in [7] it is shown that inert m_i and heavy m_g body weights are connected by simple dependence

$$m_i = m_g(\alpha_p + \alpha_c)$$

This formula shows that in the absence of the effect of gravitational induction, that is, with equal zero of the coefficients α_p and α_c, the inert body weight m_i is zero. The practical impossibility of such a "zeroing" of the inertial mass confirms the feasibility of using the concept of gravitational induction in the phenomenological description of gravity. Gravitational induction is an important factor in the description of gravitational effects with accelerated movement of the masses. For example, when calculating the dynamics of take -off of a heavy rocket, the absolute value of the coefficient allows you to find an amendment to the acceleration of the gravity affecting the rocket, and as a result increase the accuracy of determining its trajectory.

7. Conclusion

The phenomenon of gravitational induction is just as real and diverse in its practical consequences as well-known electromagnetic induction. The study of dynamic phenomena in gravity using the concept of gravitational induction contributes not only to a deep understanding of gravity physics, but also to solving practical problems.

Note:

Described earlier results of accurate weighing of mechanical rotors with a horizontal rotation axis, as well as a strong negative temperature dependency of the physical weight of bodies, contradict the widely known relativistic theories. Although among the supporters of relativistic gravity models, there is a common opinion that gravity as the most fundamental interaction "does not require empirical justification", we do not share such an extreme point of view and proceed from the belief that experience was and will remain the basis of adequate physical theory and the most important factor in scientific progress. Mathematical constructions using multidimensional spaces, curvature, etc., with all their external attractiveness ("beauty") are useless in the description of reality and do not contribute to progress in physics.

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