Concept Paper

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Probing the Gravitational Effects of Rotating Masses in a Vacuum via the Proposed Equations

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Probing the Gravitational Effects of Rotating Masses in a Vacuum via the Proposed Equations

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Abstract: This study investigates the gravitational influence of a rotating object on a nearby smaller object in a vacuum environment. Our results, which are based on the proposed equations, demonstrate the substantial gravitational effects induced by the rotating object. These findings have implications for unconventional gravity-generation methods for orbiting satellites and terrestrial applications. Additionally, this study enhances our understanding of the interplay between angular velocity and gravitational forces.

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1. Background and Scope

Research into gravitational interactions between objects has been conducted through foundational experiments, notably the Cavendish experiment [1] and Galileo's studies on free fall [2]. The Cavendish experiment and related setups yielded measurements of the gravitational forces acting between small masses. Galileo's research focused primarily on gravitational acceleration. However, neither approach comprehensively explores the impact of angular motion on gravitational interactions between masses. As a result, a disparity persists in our understanding of gravitational events in controlled laboratory environments.

We hypothesize that, a rotating mass m with angular velocity ω generates a significant gravitational field g_{Object} in vacuum, capable of exerting a notable gravitational influence on a nearby smaller mass m'.

In the following sections, we present the experimental setup and introduce a mathematical framework that forms the basis of our hypothesis.

2. Proposed Experimental Configuration

2.1. Vacuum Chamber Specifications

The experimental setup included a vacuum chamber to minimize air resistance. Furthermore, the chamber is designed to reduce boundary effects by ensuring adequate wall separation.

2.2. Key Objects and Properties

- *Object A*: A uniform sphere with a mass of 100531 kg, a density of 3 g/cm^3, and a diameter of 4 meters.
- *Object B*: A smaller sphere with a mass of 523.6 kg, a density of 1 g/cm^3, and a diameter of 1 meter.

2.3. Key Conditions

1. *Object A* is located at the geometric center of the chamber and is stabilized by an supporting structure. The object is immobile with respect to translational movement but exhibits a constant angular velocity of $\omega = 5\,\text{rad}/\text{s}$, oriented along its principal axis of rotation, directed from north to south.
2. *Object B* is located at the North Pole and maintains a separation of $r = 1\,\text{m}$ from the surface of *object A*, where it may be in motion or remain stationary.

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2.4. Predicted Outcomes

Quantifiable deviations or alterations in the state (rest or motion) of *object B* at a specified distance of 1 m.

3. Mathematical Analysis for Prediction

3.1. Gravitational Acceleration Acting Toward the Center of Mass

Gravitational acceleration is typically described as $g = \frac{GM}{r^2}$ [3]:

- g is the gravitational acceleration of *object A*.
- G is the gravitational constant ($6.6743 \times 10^{-11}\,\mathrm{Nm^2kg^{-2}}$).
- M_A is the mass of *object A* (100531 kg).
- r is the radial distance from the center of mass of *object A* to the location of *object B* (3 m).

By substituting the given parameters:

$$g_\mathrm{A} = \frac{(6.6743 \times 10^{-11}) \times 100531}{3^2},$$

yields:

$$g_\mathrm{A} \approx 7.46 \times 10^{-7}\,\mathrm{m/s^2}.$$

3.2. Gravitational Acceleration via the Proposed Equation

The rotational component of gravitational acceleration is given by:

$$g_\mathrm{rotational} = \frac{\omega^2 \cdot R^3}{r^2}.$$

The given parameters are as follows:

- $g_\mathrm{rotational}$ is rotational component of the gravitational acceleration of *object A*.
- ω is the angular velocity of *object A* (5 rad/s).
- R is the radius of *object A* (2 m).
- r is the radial distance from the rotational axis of *object A* to the location of *object B* (3 m).

By substituting the given parameters:

$$g_\mathrm{rotational} = \frac{5^2 \cdot 2^3}{3^2},$$

we obtain:

$$g_\mathrm{rotational} \approx 22.22\,\mathrm{m/s^2}.$$

4. Insights into the Proposed Mathematical Model

4.1. Basics

Equation $g_\mathrm{rotational} = \frac{\omega^2 \cdot R^3}{r^2}$ elucidates:

- It can be simplified into a configuration, which yields an angular velocity (rad/s) at a specified distance, instead of acceleration $(\mathrm{m/s^2})$:

$$w' = \frac{w \cdot R^2}{r^2}.$$

- The inverse-square dependence on distance (r^2 in the denominator) implies that the angular velocity ω' decreases with increasing radial distance from the axis of rotation, following the inverse square law ($\omega' \propto r^{-2}$) [4].
- Unlike the gravitational force $\vec{F}$, which is directed toward the center of mass, the $g_\mathrm{rotational}$ and ω' aligns with the angular velocity vector $\vec{\omega}$ and the surface curvature of the rotating mass.

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4.2. Limitations

- In general relativity [6], angular velocity around a rotating mass is expressed as $\Omega_{LT} = \frac{2GJ}{c^2 r^3}$ [5], where G is the gravitational constant, J is the angular momentum of the central mass, c is the speed of light and r is the radial distance from the rotating mass. In contrast, the proposed equations of $g_{\text{rotational}}$ and ω' adopt a classical approach and are not applicable in relativistic contexts.
- Both equations assume a frictionless environment in which gravity is the only external force acting on the rotating mass.

5. Conclusions

5.1. Implications of Calculations

The rotational component of gravitational acceleration ($22.22\,\text{m/s}^2$) calculated for *object A*, exceeds both the gravitational acceleration of the Earth ($9.8\,\text{m/s}^2$) and the gravitational acceleration acting toward its center of mass ($7.46 \times 10^{-7}\,\text{m/s}^2$). This inequality:

$$g_{\text{Earth}} < g_{\text{rotational, A}} > g_{\text{A}},$$

indicates that *object A* can substantially influence *object B*.

5.2. Pathways for Future Investigation

Future theoretical or experimental research could explore the following:

- Variations in density, dimensional scaling, and angular velocity within the system.
- Interaction of multiple rotating objects with different or identical masses.

5.3. Potential Applications

1. The generation of gravity achieved by localized fields emanating from rotating masses.
2. The proposed equations may have applications in the dynamics of planetary systems, particularly in understanding rotational effects.

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