Is it possible to control gravity on the Earth's surface?

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Abstract: It is shown that using changes in the planet's rotation speed, one can easily control gravity on the surface of any planet, including the Earth. The acceleration of rotation will lead to a decrease in gravity on the surface of the planet, up to a state of weightlessness; and slowing down the rotation leads to an increase in gravity. Moreover, the energy for such transformations will be available to humanity in the near future, which will make it possible to control gravity on Earth and make most of the planets suitable for human life.

Keywords: gravity control, centrifugal force, planet Earth, Solar System, Dyson Sphere, planetary colonization.

INTRODUCTION.

On planet Earth, in the future, we will be able to control gravity. If we want...

It has long been debated that in the future, people will build artificial housing in which they can control gravity. The reduction of gravity is based on the use of centrifugal force. These projects include the Dyson Sphere [1], Niven's Ring World [2], and other similar designs. No, this will not happen, since with such a large area there will be incredible overloads of materials, plus you also need to protect such an area from meteorites and other cosmic bodies - it will be difficult to do this.

Therefore, we will go the other way... And we will control gravity on the entire surface of the Earth, using the change in the rotation speed of the planet. Naturally, we will also use centrifugal force. Nature has been using this method for a long time, as can be seen if you look at the planets of the Solar System. Let's start with physics.

RESULTS AND DISCUSSION.

If the body moves in a circle of radius r, with linear velocity v, then the centrifugal force will act on this body, directed radially from the center of the circle. The centripetal acceleration of the body will be directed radially to the center of the circle, and is equal to:

$$a = v^2 / r$$

According to Newton's second law, if a body of mass m moves with acceleration a, then a force F acts on it.

$$F = m * a$$

We clearly feel the centrifugal force when we ride the carousel. Planet Earth is also a huge merry-go-round, and therefore, apart from gravity (m * g), we are also affected by centrifugal force (m * a). Let us analyze these forces in more detail.

Let's say we have a body of mass m on the planet's surface. This body will be attracted to the center of the Earth with the force F1:

$$F1 = m * g = 1 * 9.81 = 9.81 \text{ N}$$

The centrifugal force F2 will act on this body in the opposite direction, from the center of the Earth upwards (consider the case at the equator).

$$F2 = m * a = 1 * v^2 / r$$

where v - is the linear speed of the Earth's rotation at the equator (465.1013 m/s) [3],

r - is the radius of the Earth ($6.371 * 10^6$ m).

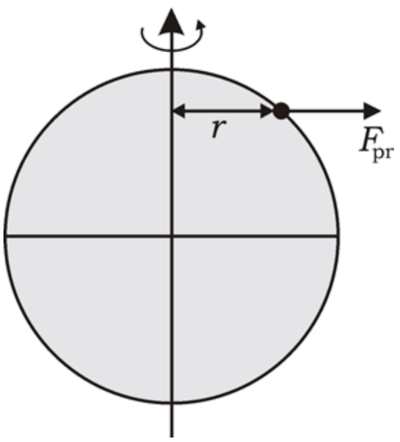
Let's calculate the value of the force.

$$F2 = m * a = 1 * v^2 / r = 0.033954 \text{ N}$$

Consequently, the centrifugal force (F2) is almost 300 times less than the gravitational attraction to the Earth (F1).

$$F1 / F2 = 288.92$$

Note that the linear speed of rotation at 60° latitude is two times less than at the equator, since points on the earth's surface (at higher latitudes) are closer to the axis of rotation. In general, the linear velocity of the Earth's rotation at an arbitrary latitude and altitude is calculated using a special formula [4].



We will consider the case at the planet's equator, where all the centrifugal force goes to compensate for the force of gravity. At an arbitrary latitude, only the normal component (to the surface) of centripetal acceleration will compensate for the force of gravity. Moreover, the normal component decreases towards the poles. It is for this reason that the acceleration of gravity depends on latitude: the closer to the pole, the greater it is. Since with increasing latitude, the angle between the vector of centrifugal force and the plane of the horizon decreases, which leads to a decrease in the vertical (normal) component of the centrifugal force; in addition, points on the earth's surface have a lower linear velocity (closer to the axis of rotation).

If we increase the linear speed of the Earth's rotation, then the gravitational attraction will decrease, since the centrifugal force compensates for it. It is easy to calculate the speed of rotation of the Earth when the gravitational attraction is equal to zero, that is, when there is a state of weightlessness on the surface of the planet (more strictly, at the equator).

$$F1 = F2$$

$$m * g = m * a$$

$$v^2 / r = g$$

$$v^2 = g * r = 62.436 * 10^6$$

$$v = 7.902 * 10^3 \text{ m/s}$$

Consequently, if we increase the linear speed of the Earth's rotation by 17 times, then on the surface of the Earth there will be a state of weightlessness.

$$v2 / v1 = 7.902 * 10^3 / 465.1013 = 16.989$$

If we want to reduce the weight of the body on Earth by 2 times, then the linear speed of the Earth's rotation must be increased by 12 times.

$$v^2 = (g * r) / 2 = 31.250 * 10^6$$

$$v = 5.590 * 10^3 \text{ m/s}$$

$$v2 / v1 = 5.590 * 10^3 / 465.1013 = 12.019$$

This fact is well demonstrated by our Solar System: planets that have a much greater mass than the Earth, but which rotate faster than the Earth, have an acceleration of gravity approximately equal to that of the Earth.

Compare.

Uranus [5]. The mass is 14.54 times greater than the Earth. The linear rotation speed is 5.57 times greater than that of the Earth (the rotation speed is 2.59 km/s, and that of the Earth is 0.465 km/s). The acceleration due to gravity (at the equator) is 8.87 m/s^2.

Neptune [6]. The mass is 17.147 times greater than the Earth. The linear rotation speed is 5.76 times greater than that of the Earth (the rotation speed is 2.68 km/s). The acceleration due to gravity (at the equator) is 11.15 m/s^2.

Saturn [7]. The mass is 95.2 times greater than the Earth. The linear rotation speed is 21.23 times greater than that of the Earth (rotation speed is 9.87 km/s). The acceleration due to gravity (at the equator) is 10.44 m/s^2.

Therefore, if we can increase the speed of rotation of the Earth, then we will decrease the gravity of the planet at will (on the surface). At the same time, of course, the earth's day will become smaller, but with an artificial sun over a country or a metropolis, this will not be a problem.

Next, let's analyze the amount of energy that we need to accelerate the Earth's rotation. For example, let's calculate the energy that is needed to move the Earth 1 meter. Moreover, we will move the Earth carefully, slowly, so we will take the acceleration equal to 1 m/s^2.

M (Earth) = 5.9722 * 10^24 kg

L = 1 m

a = 1 m/s^2

E = F * L = M * a * L = 5.9722 * 10^24 J

The resulting energy value is large (E = 5.9722 * 10^24 J), but quite attainable for humanity in the near future.

For comparison, the energy of the largest nuclear explosion, that is, the energy of the Tsar Bomb detonated in 1961 in the USSR, is 2.4 * 10^17 J [8]. This is about 20 million times less than what we need to move the Earth 1 meter. The energy of the Tsar Bomb corresponds to a mass defect of 2.65 kg.

Note that when calculating the energy of displacement, we took the acceleration as 1 m/s^2, but if the acceleration is less, for example, 100 or 1000 times, then the energy will be required 100 or 1000 times less. Consequently, with an increase in the power of nuclear explosions and a decrease in acceleration, the required energies are quite achievable. Even now.

It is most logical and economical to use the energy of antimatter annihilation. Then, to move the Earth, it is necessary to use approximately 27 thousand tons of antimatter. This is the mass of a small ship. Therefore, in the future, it will be quite realistic to do it.

CONCLUSION.

Thus, to reduce gravity on the surface of the Earth, humanity will have to slightly increase the rotation of our planet. The energy for such a procedure will be available in the near future. The implementation mechanisms can be different: 8 - 10 directional impulses may be needed, or may be 1 million directional impulses... The important thing is that this is practically realizable.

Before accelerating the rotation of the Earth, our civilization can train on another planet. For example, on Mars. Since its mass is 9.35 times less than the mass of the Earth, and therefore less energy is required. Or on Venus, which is excellent for this role, since it is similar in mass to the Earth (0.815 Earth masses), has a dense atmosphere, and rotates very slowly around its axis: one revolution in duration is equal to 243 Earth days. And there is also a small Mercury, which has 18 times less mass than the Earth... In general, we have an excellent experimental laboratory.

In this laboratory, it will be necessary to study how the wind speed, the movement of air and liquid masses will change, since with an increase in the rotation speed, the Coriolis force will increase, which plays an active role in the formation of weather and climate on the planet [9]. There is no doubt that all these characteristics can be adjusted at will, for example, using a set of artificial suns. Therefore, in the future, our Earth can be made very comfortable for living.

By increasing or decreasing the speed of rotation of the planets, the planets "unsuitable" for life can be made suitable for life. It's simple. Physics is really elementary. Since gravity is adjusted for "man", which means that the gas composition of the atmosphere will not dissipate (it can be filled with the necessary gases). And if an artificial sun is present, then in fact most of the planets (in the future) can be made suitable for human life.

Therefore, first, humanity colonizes the planets of the Solar System, and then we move on to the colonization of our entire galaxy and its planets. Well, only after that we will start colonizing all galaxies and the Universe as a whole... Ahead, great times await humanity!

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