2.1 Geostationary orbits

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Abstract

Respecting the mechanism of simple machines, in described case the lever in balance, the application of universal principle (*g=cd*) is demonstrated by calculating the radius and velocity of the geostationary orbit. Derived is the ratio between geostationary and equatorial radius, specific to each celestial body. Implicitly, formulated is the law of geostationary orbits symmetrical to third Kepler's law of planetary motion. As a derivation of these equations is not using the gravitational constant G and calculates the corrected celestial body masses, due to their mathematical equivalence, equalities presented give absolutely accurate results. The elegance, precision and simplicity of the presented model indicate misinterpretation of Newton's arbitrary masses and nature, in the conventional physics inevitable gravitational constant *G*, the so-called "Universal constant of nature".

2.1.1 Brief description of geostationary orbits

Equatorial rotation speed of our planet around its axis amounts 465.11 meters per second. In regard to fixed stars, by rotating at that speed, it takes 23.934461223 hours for Earth to turn the full circle. Earth's orbital velocity is 7,906.255 meters per second. This means that in each second, the body traveled this path perpendicular to the radius, but as it at the same time falls for the corresponding acceleration, in any point of time its motion is tangential relative to our planet. Therefore, the trajectory of the body at all times uniformly bends towards the center and body orbits the Earth. From the geometric relationships of radius r and orbital velocity, to the orbital velocity and surface acceleration a, and a symmetrical relationship of light speed c and the orbital velocity to the orbital velocity and gravity g (2.1.1.1, 2.1.1.2), derived are the equations for orbital velocity v_o (2.1.1.3, 2.1.1.4), from which equality (2.1.1.3) is known (Figure 2.1.1.a).

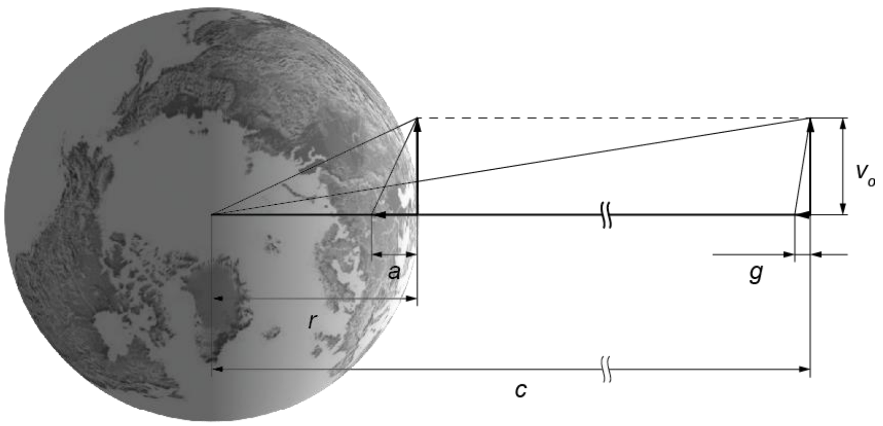

Figure 2.1.1.a *Geometric relationships of triangles r, v_o, to v_o, a, and a symmetrical relationship of triangles c, v_o to v_o, g. The triangles in both groops are proportional. For bether readability, in this*

particular figure, the ratio of radius c and r is much smaller then in reality.

$$\frac{r}{v_o} = \frac{v_o}{a} \qquad 2.1.1.1$$

$$\frac{c}{v_o} = \frac{v_o}{g} \qquad 2.1.1.2$$

$$v_o = \sqrt{ar} \qquad 2.1.1.3$$

$$v_o = \sqrt{cg} \qquad 2.1.1.4$$

If the body is moving at that speed on the surface of the Earth, it would need a little less than an hour and a half to go around the Earth. (It is actually the pendulums period T in which, according to the known equality (2.1.1.5);

$$T \approx 2\pi\sqrt{\frac{l}{a}} \qquad 2.1.1.5$$

arm length *l* equals to the radius of the planet). Therefore, the period of the Earth's orbital velocity is some 17 times shorter than the period of the Earth's rotation.

Television satellites are specific because of the fact that their period shall be equal to the sidereal period of Earth’s rotation around its axis. Due to these properties, television satellites are geostationary.
Acceleration and orbital speed fall with the square of the distance from the center of the orbiting body, which means that the further away from the Earth's surface, the orbital velocity will decrease. In very specific orbit, it would take precisely 23.934461223 hours for its velocity to close its scope. It means that this orbital point, if at the equatorial plane, rotates together with our planet, so its position in relation to an observer located on the surface, stays unchanged. Therefore, set angle of the satellite dish will be permanent. The scenario is identical to that if we build a television tower of 35,788 kilometers height, because at that distance, measured from the equator, orbital period equals to the rotation period of the Earth (Figure 2.1.1.b).

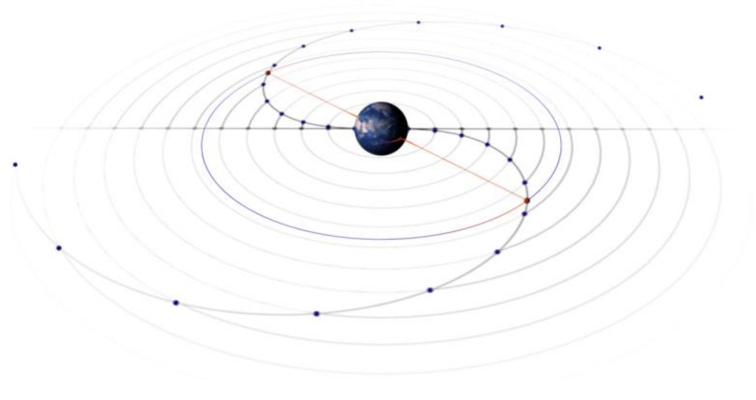

Figure 2.1.1.b *Grid of Earth's equatorial plane divided in its planetary radiuses with graphical presentation of orbital delays (the function bends like a fishing rod). Geostationary orbit points (6.611*

Earth's radiuses from its centre) are synchronized to corresponding points on Earth. Movie clip Geostationary orbit shows it in motion.

That amount is not random, and its explanation indicates a deep connection between the nature of space, time, velocity and mass.

The television satellite orbit principle is actually the principle of the lever which is in equilibrium (Figure 2.1.1.c.).

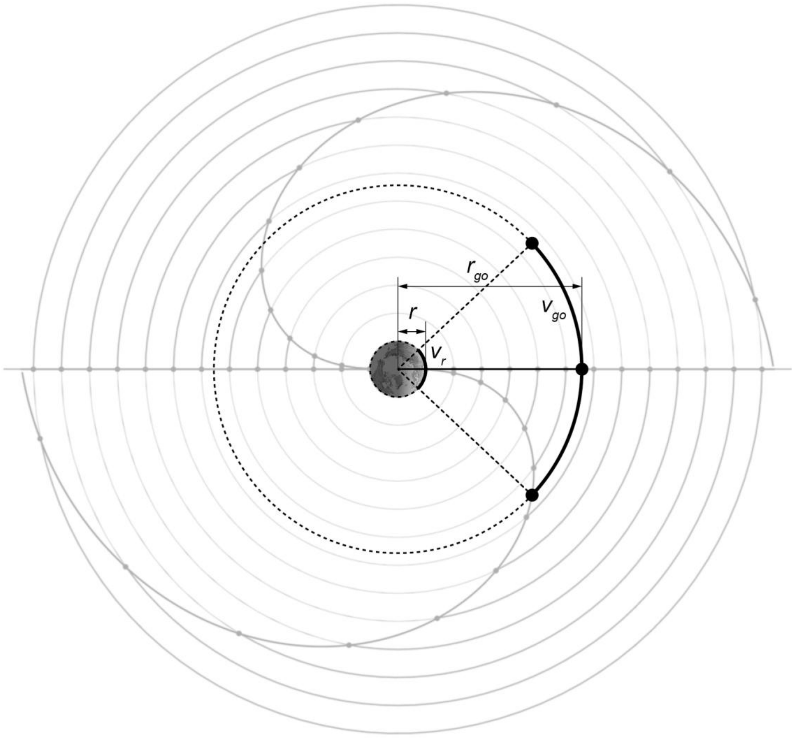

Figure 2.1.1.c *Geostationary orbit as a second class lever. Both radiuses r and r_{go} represent legs, i.e. distances from its fulcrum.*

2.1.2 Principle of geostationary orbits

If we, according to classical formula for linear momentum *p* (2.1.2.1),

$$p = mv \qquad 2.1.2.1$$

where *m* and *v* are mass and speed of the observed system, include the relations for our planet mass M_r in area of its radius *r* and Earth's equatorial speed v_r, with Earth's mass M_{go} in area of the required orbit r_{go} and its required speed v_{go}, where masses are calculated by formulas (0.0.30) and (0.0.31), we get the relationship (2.1.2.2);

$$M_r v_r = M_{go} v_{go} \qquad 2.1.2.2$$

For lever to remain in balance, if we increase the mass, the arm must be reduced for the same ratio. How, therefore, the mass is reciprocal equivalent to levers arm, in this case the radius, it is the same if we write (2.1.2.3) (Figure 2.1.1.c);

$$r_{go} v_r = r v_{go} \tag{2.1.2.3}$$

where *r* and r_{go} are radiuses of Earth and orbit required.
Since the relations of masses and reciprocal relations of radiuses equal to the relations of orbital velocities squared (0.0.32), instead of the specified values, we incorporate squares of Earth's orbital velocity and the required speed v_{go} (2.1.2.4);

$$v_o^2 v_r = v_{go}^2 v_{go} \tag{2.1.2.4}$$

Therefore, the orbital velocity of television satellites v_{go} is equal to the third root of the product of the orbiting body equatorial velocity and the square of its orbital speed (2.1.2.5);

$$v_{go} = \sqrt[3]{v_r v_o^2} \tag{2.1.2.5}$$

which equals to (2.1.2.6, 2.1.2.7);

$$v_{go} = \sqrt[3]{v_r r a} \tag{2.1.2.6}$$

$$v_{go} = \sqrt[3]{v_r c g} \tag{2.1.2.7}$$

where *a* is the acceleration of the surface, *r* is the radius of the planet, *c* is the speed of light and *g* is the gravity of one light-second space radius from the center of the planet. From the equation for orbital velocity at a distance *n* (0.0.40), derived is the equality for distance, i.e. geostationary orbital radius r_{go} (2.1.2.8);

$$r_{go} = \frac{a r^2}{v_{go}^2} \tag{2.1.2.8}$$

The above equality is equivalent to the relation (2.1.2.9) derived from the equation (2.1.2.3);

$$r_{go} = r \frac{v_{go}}{v_r} \tag{2.1.2.9}$$

Which is by incorporating (2.1.2.6, 2.1.2.7) equal to (2.1.2.10, 2.1.2.11, 2.1.2.12);

$$r_{go} = \sqrt[3]{\frac{r^4 a}{v_r^2}} \tag{2.1.2.10}$$

$$r_{go} = r\sqrt[3]{\frac{cg}{v_r^2}} \quad 2.1.2.11$$

$$r_{go} = r\sqrt[3]{\frac{v_o^2}{v_r^2}} \quad 2.1.2.12$$

As equalities for geostationary orbit radius count distance from the center of rotation, for the satellites altitude calculation *h*, compared to an observer located on the surface, from obtained amount, the equatorial radius of observed planet is subtracted (2.1.2.13);

$$h = r_{go} - r \quad 2.1.2.13$$

From equation (2.1.2.12) follows that the ratio of the radius of the observed body and its geostationary orbit equals the third root of the squared fraction of corresponding orbital and equatorial velocity. Therefore, we introduce the coefficient k_{go}, specific to each observed celestial body (2.1.2.14);

$$k_{go} = \sqrt[3]{\frac{v_o^2}{v_r^2}} \quad 2.1.2.14$$

As displayd in figures (2.1.1.b,c), k_{go} for planet Earth amounts 6.611.
Follows that the equality for the geostationary orbit radius can be written (2.1.2.15);

$$r_{go} = rk_{go} \quad 2.1.2.15$$

Implicitly, we formulate the law of geostationary orbits;

Squared ratio of orbital and equatorial velocities is directly proportional to the cubed ratio of geostationary and equatorial radiuses (2.1.2.16).

$$\frac{v_o^2}{v_r^2} = \frac{r_{go}^3}{r^3} \quad 2.1.2.16$$

Presented law of geostationary orbits is symmetrical to third Kepler's law of planetary motion, which says that the square of the orbital period of a planet is directly proportional to the cube of the semi-major axis of its orbit.

2.1.3 Conclusion

Respecting the principle of lever, derived are universal equalities for the required values of geostationary orbits, expressed through relationships of radius *r*, surface acceleration *a* and equatorial rotation speed v_r of the observed celestial body. Unlike conventional equations, which account unexplained physical entity, the gravitational constant *G*, and by using the same constant incorrectly calculated planetary masses, specified values can be obtained by measuring the distance between two rods and the length of their shadow, acceleration of stone in a free fall or the length of pendulum which period equals 2π time units (2.1.1.5).

Due to the tautological symmetry of radius and acceleration to the speed of light and gravity (0.0.16), the same equalities of gravitational world of "big" were presented by calculating the speed of electromagnetic waves of the world of "small", i.e. the speed *c*.

Also presented is a specific coefficient k_{go}, a ratio of observed body radius with a radius of its geostationary orbit. Implicitly, formulated is a universally valid law of geostationary orbits.