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# GRAVITY AND INERTNESS

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Consider one more aspect related to the inertness or body mass. The problem of the difference between gravitating and inertial masses has long been discussed in Newton's laws of motion. Some physicists believe that these masses can be different. A lot of thin and rather precise experiments were performed with the aim of finding the difference between gravitating and inertial masses [1-4]. No difference has been found so far [5]. On the basis of the approach discussed above, it can be stated that this difference must not exist since inertness and mass are equivalent categories.

Imagine that force $F_t$ is acting on some inert mass according to Newton's second law and acquires acceleration $a$, which is inversely proportional to a body with mass $m$.

$$F_t = ma, \tag{1}$$

The gravitational field acts on mass $m$ as some force $F_g$. This force arises because the gravitational field (of the Earth, Sun, intergalactic field etc.) is gradient [6]. When a body of one and the same mass $m$ acquires acceleration by force $F_t$ or gravitational force $F_g$, the forces and acceleration of the body can be variables, but the mass cannot. The well known experiments of physicist R. Eötvös prove only the fact that bodies possessing any physical properties and masses move in a gravitation field in a similar way [1, 7]. Thus, the inertial and gravitational masses are equal since they have one and the same basis – the body's inertness or, otherwise, the effort of the body to maintain its state in attempting to change this state.

At the same time, peculiarities of the force application during acceleration of a body in a gravitational field and through contact with another body differ greatly. As mentioned above, every motionless body (for instance, lying on a support) in the gravitational field possesses potential energy. A motionless body in the gravitational field experiences internal loads and strains.

To demonstrate this, let us divide the motionless body on the support into several parts. The parts that are lying nearer to the support, experience greater loads than those further away due to the pressure from the overlying parts (the load on our feet is greater than that on our shoulders). Our soles undergo the pressure equal to our body weight. The pressure perception in our body is the ponderability perception. Internal loads and strains also arise in a body that is accelerated by some force. This body can also be divided into several parts. It will turn out that the parts located near the point (surface) of the accelerating force application, experience the greatest internal loads and strains. In such bodies, forces (causing acceleration) are applied locally, i.e. at a point, plane or surface.

Imagine a free-moving closed capsule (lift) in which some physical body is situated. Does the gravitational field inside this capsule disappear or decrease? It would happen if the capsule velocity was greater than the propagation velocity of the gravitational field. As experience shows, gravity is not virtually shielded by other (not very massive) bodies. So the gradient field of gravitation will accelerate the body in the capsule and the capsule itself with equal velocity.

The Great Galileo was the first to show that light and heavy bodies fall with equal acceleration in Earth's gravitational field. The most pictorial experiment demonstrates a fall of a lead pellet and bird feather in an evacuated glass tube. It is clearly seen that both fall with equal acceleration. If we divide some body into pieces and follow the fall of the pieces in a vacuum, we shall see that both large and small pieces fall with equal acceleration in Earth's gravitational field. If we continue the division down to atoms we shall see the same result. Hence it follows that a gravitational field is applied to every elementary particle possessing mass and constituting a physical body. It will accelerate large and small bodies with equal velocity only if the field is gradient and acts on every elementary particle of the body.

A gravitational field is really gradient. The force action on an elementary particle can be compared with the liquid pressure on the body submerged in it [8]. Such an interpretation allows explaining the ‘zero-gravity” state that a freely falling body experiences. In classical mechanics, the zero-gravity perception is interpreted in the following way [9]: “What is zero-gravity and how should it be understood from the viewpoint of mechanics? First of all note the following. The human nervous system delivers information to the brain about how one part of the body weighs upon another…” “If surface forces are absent, for instance, when we fall from a height before the parachute opens (air resistance is disregarded), then the pressure of the one part of the body on another is missing and zero-gravity perception arises.”

In free-fall, a physical body starts moving in the direction of the field gradient decrease. If we divide this body into some separate parts (particles) it will appear that an equal gradient pressure is applied to every one of these particles (if the gradient change within the body's length is disregarded). We showed above that both large and small (and minute) bodies are accelerated with equal velocity in a gravitational field. Hence it follows that gravitational pressure is distributed in such a way that it is applied to every atom (including its nucleus and electrons) constituting the body. The gravitational pressure is not applied to the body as a whole at some point or surface; it is distributed and acts inside the body. Every part and every atom gets equal acceleration in the gravitational field. Since accelerations gained by the parts (particles) constituting the body are equal, stresses and strains are missing between these parts and the state that is called weightlessness is realized. Weightlessness is exactly the state when internal stresses among the body parts are missing (if, for instance, a long bar oriented in the direction of a gravity gradient is not considered).

Note that unlike the body that rests on a support and is in a gravitational field, the gravitational force in the body that is free from external relations is not applied locally, but acts equally on every particle constituting the body. In this state, gravity is responsible for acceleration, an increase in the velocity of a body in the free motion towards the centre of gravity. If the force applied to the body through the contact point or surface is the vector measure of mechanical manifestation of the bodies’ interaction, then the gravitational force is the distributed gradient pressure on every elementary particle constituting the body.

Thus, gravitational activity is possible due to the fact that the gravitational field is a gradient one and its gradient is applied, not to some point of the body or its part or to the body as a whole, but to every elementary particle constituting this body. But in order that the gradient field delivering its gradient pressure to every elementary particle should exist, a medium freely penetrating into all physical bodies without exception must be available. Only in this case will the principle of close-range interaction be observed. A medium that penetrates into all physical bodies freely and exerts the gradient pressure of gravitation is called ether or the ether medium [8]. Gravitational action through the ether medium disappears neither in the body lying motionlessly on the support nor in the body that is in free-fall. The gradient pressure of the ether medium in the body lying motionlessly on the support acts through forces on every elementary particle. These forces add up together to give a resultant pressure of the body on the support. We call this pressure the body weight. Deformations occur inside the body. The closes the area under consideration inside the body to the support, the greater the deformations.

In free-fall, the gradient pressure of the ether medium is distributed inside a body. It acts on every elementary particle inside a body and its value remains the same as in a motionless body. The gradient pressure of the ether appears because the sizes of the ether particles are estimated to be much less than those of the elementary particles constituting physical bodies. Analysing the effective polarizability of the ether particles, A.A. Potapov [10] arrived at the conclusion that their size is equal to the Planckian length:

$$a = l_p = \sqrt{\frac{hG}{2\pi C^3}} = \sim 1 \cdot 10^{-32}\ mm,$$

where $h$ is Planck's constant, $G$ is the gravitational constant, $C$ – is light velocity.

This size is several orders less than the size of elementary particles. As is well known, atom sizes including their electron shells are fractions and units of angstroms, i.e. ~ $(1\text{-}10)\cdot 10^{-10}$ m. Nuclear sizes are z ~$10^{-14}$ *m*. The electron radius (classical) is $2.818\cdot 10^{-15}$ *m* [11]. The sizes of other elementary particles are not too different from those of electrons and can be no more than two orders less. If we compare the sizes of the ether particles (~$1\cdot 10^{-35}$ *m*), nuclei and electrons, we shall see that ether particles can easily penetrate and take places among atoms in intra-atomic space. Light penetration into transparent bodies (the wave length, for instance, of visible light is $(4\text{-}7)10^{-7}$ *m* [12]) corroborates the similarity of the base which oscillates, being excited by the light quanta both in the vacuum and inside the bodies [13]. A physical body composed of atomic nuclei and electrons represents a kind of space "lattice" inside of which the ether is situated. Its gradient pressure on nuclei and electrons constituting this "lattice" gives rise to gravitation force.

From the above, it follows that the ether medium is an essential subject of classical mechanics and cannot be excluded from it. The presence of the ether medium allows the nature of gravity to be explained [8]. At the same time, there are concepts denying the existence of the ether medium. At present, dozens of versions of gravitational theory have been suggested [14]. One of the best known, is set forth in the general theory of relativity (GRT). According to this theory there is a correlation between gravitation and inertness. This correlation is explained by the fact that gravitation and inertness seem to be the same thing, because they are the same thing. In GRT, this correlation is called the equivalence principle. According to A. Einstein's letter to E. Mach, the equivalence principle lies in the equivalence of an accelerated system and a gravitational field ([15], p.169). In other words, by this theory, in a lift moving in the cosmos with acceleration exactly equal to the acceleration of the body falling to the Earth, a force equal to the earth gravity will be created artificially. It is reasonable that this imaginary cosmos should be devoid of a gravitational field.

It can be shown with relative ease that there is a fundamental difference between the state of the body that is in a gravitational field with the gravitation constant $G$ and the state of the body speeded up with the same acceleration $F = G$. Let us make up a body consisting of two masses united by bars as shown in Fig. 1a. Let us build the dynamometer $D_1$ into the horizontal bar. Let us make up the second body with the same composition as the first one with the dynamometer $D_2$, Fig. 1b. The first body is speeded up by the force $F$ with acceleration equal to $G$ in space unable to display the gravitational force. The second body is in stable equilibrium in the gravitational field with an acceleration $G$. It is easy to notice that the readings of dynamometer $D_1$ on the body of Fig 1a will be greater than those of dynamometer $D_2$ on the body of Fig. 1b since the body masses in Fig. 1b will be attracted to each other. This example clearly shows the inconsistency of the equivalence principle. But this example demonstrates only the correctness of Newton's second law. When we imitate gravitation in the body that is in the lift moving up, the distributed gravitational field is absent.

It is easy to explain the formation mechanism of the weightlessness state inside a satellite moving on a near-Earth orbit with our concept of the gradient gravitational field. As applied to the body situated on the Earth orbit, the Earth's gravity plays the role of the force $F_c$:

$$F_c = \frac{1}{R} m V^2,\ kg\cdot m^2/s^2, \qquad (2)$$

where $R$ is radius, $m$ is mass, $V$ is linear velocity of the body movement along the orbit.

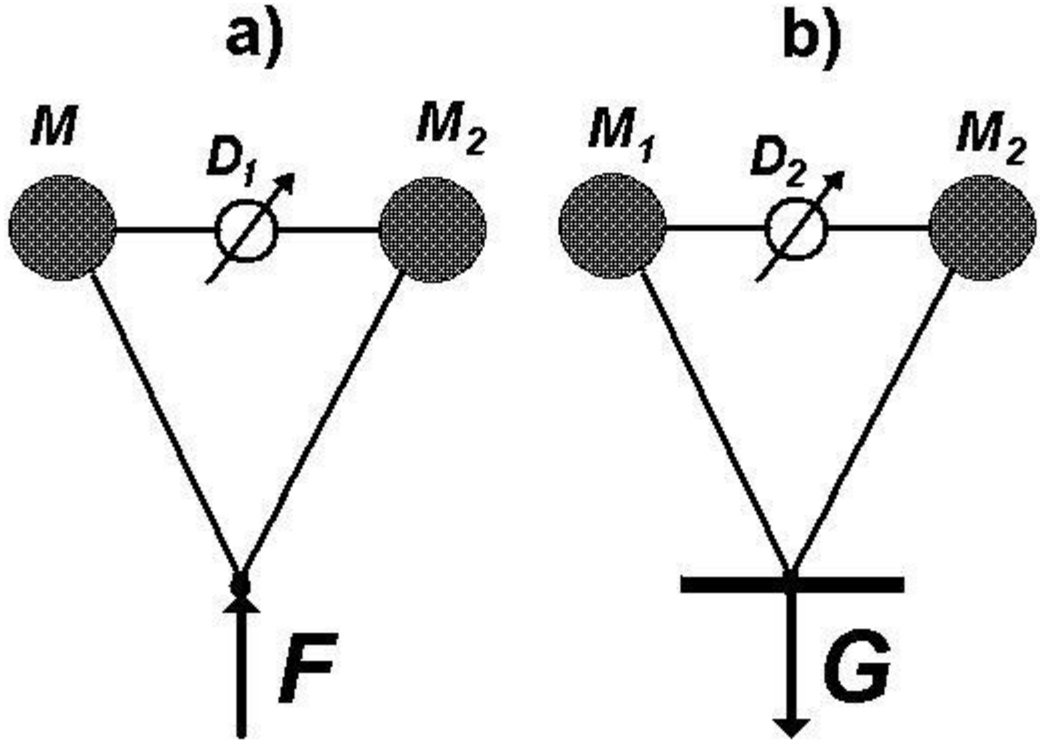


Fig. 1. The diagram showing the difference between the state of a body accelerated by a physical force (a). and that of an immobile body in the gravitational field (b).

In this case $F_c = mg$, where $g$ – is the acceleration of the gravity force. The average value of earth's acceleration is $g = 9.81\ m/s^2$. Substituting the value of the centripetal force that ensures the value of earth gravity in Eq. 2 we obtain that in an Earth-circling orbit (excluding the influence of the Earth form, the Moon, the Sun etc),

$$g = V^2/R. \tag{3}$$

In this case, the centripetal force caused by Earth's gravity will be balanced by the centrifugal force of inertia $F_c$ similar to Euler transportable force $\boldsymbol{P}$ [16]. The centrifugal force $F_c$, as well as the gravitational force, acts equally on every part, particle and atom of the orbital physical body balancing the gravitational force. Therein lies the cause for the zero-gravity of bodies in Earth orbit. Note that according to Eq. (3), all bodies independent of their mass, that have reached the circular velocity $V$, will become "weightless".

As a result note that it is just the gravitational force representing the gradient pressure on every elementary particle constituting a physical body that causes all bodies to fall with equal acceleration. The great scientist Galileo Galilei, was the first to establish this fact. Accepting the concept that gravitation is a distributed gradient pressure resolves the problem of identity of gravitating and inertial masses.

The above arguments show the striking fact that some problems of not only celestial, but also classical mechanics, cannot be solved without the ether concept. It is appropriate at this point to cite mechanical engineer A. Ishlinsky [9]: "Are inertia forces real or unreal? Supporters of the inertia force reality advance the facts of a cord tension as a stone rotates on it, a rupture of fast-revolving flywheels, a feeling of additional gravity in a lift going up etc. They state we would not be able to distinguish the inertia forces from "real" ones if we always were underground and knew nothing about the Earth rotation around its axis and its movement around the Sun. Would we come to the Galileo-Newton ordinary laws of motion in this case? One can bring forward a large number of such examples and questions". As indicated above, the acceptance of the ether medium concept allows removing the existing contradictions.

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