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The Functional Relationship of the Gravitational and Inertial Masses

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Abstract: *Analysis of a number of macroscopic models in which an infinitely thin boundary is laid showed that the force arising at the boundary is determined, naturally, by the gradient of the macroscopic potential, and not by its microscopic gradients. The calculation of the form of the distribution of the gravitational potential near the boundary determined by the position of the accelerated object allowed us to obtain, as a first approximation, the ratio of the gravitational and inertial masses, which depends on the acceleration and the acceleration time of the object as it approaches its speed to the speed of light.*

Keywords: *logarithmic relativity, potential fields, acceleration, rigidity, shock waves, Janibekov effect.*

1. Introduction

Einstein divided the concept of gravitational and inertial masses. But the absolutization of the corrections obtained for the particle energy by velocity, which he also associated with the dependence on mass velocity, led him to postulate the equivalence of gravitational and inertial masses. In addition, the non-polar “imaginary” time fully equated it to the geometric coordinates, which simply contradicts the elementary dynamics. This led to the use of the Riemann geometry for the description of the space-time continuum, in which, unlike the time coordinate from the space coordinate, he tried to completely reflect it simply by “imaginary”. But the formal introduction of imaginary corresponding only orthogonality, say x and y, does not completely exhaust the difference from geometric coordinates from time. The flow (polarity) of time is directly related to the “imaginary” characteristic of dynamic systems that corresponds to their attenuation, i.e. the rate of leakage of energy from the system under consideration [1]. Only in an infinite Universe it is obvious that there is no place to leak energy in space - this is a leakage, first of all from the past to the future, and in case of specific considerations of the processes - from the analyzed known processes that are not considered in consideration.

I believe that Einstein himself, being a Physicist, felt the incompleteness and lack of rigor of the postulates he used, but he was in a hurry to “see” the resulting, albeit crude, but fundamentally new picture of Cosmos. As is now clear, he built only individual four-dimensional projections of the continuum with an extended dimension. But he did not abandon his search for a connection with the reality of this “elusive” missing dimension and the search for new invariants. Let not them for the first time formulated the relationship of mass and energy, it was to them that it was, as it were, embedded in the picture of the World in that it reduced the number of independent parameters. But he, on the one hand, attributed the corresponding kinetic energy corrections for velocity to the particle energy to its potential (internal) energy (violating the law of conservation of mass). On the other hand, the speed corrections were associated only with mass (without touching the law of charge conservation).

But apparently, feeling the incompleteness of the picture he had built and trying to complement it with the HARMONY MEASURE, Einstein appealed to Thermen to voice elementary geometric figures on the termenvox. Thermen, whose sense of Nature was so high that it was simply easy to make devices on principles unknown to anyone (not yet formulated) principles, unfortunately, did not become interested in Einstein’s depth of thought and dismissed it. As he told us at the Bolshoi Scientific Council Fiz.-Tekh: "Einstein was a good man, but as a physicist he is weak and I kicked him out." It may seem a strange coincidence that A.F. Ioffe, with whom Termen had complete mutual understanding and cooperation in his youth, then drove the theorist Landau out of Fiz.-Tekh, also as a weak physicist (although Ioffe's biggest mistake was that he refused to apply for Fiz.-Tech. Losev, the creator in the thirties of the last century, the world's first transistors and LEDs)[2].

But both Ioffe and Einstein, grabbing the first approximation in the description of nature, naturally, coarsened the description / calculations. So Ioffe, building a thermoelectric model and feeling that a member of the equation, formally introduced by him according to "science," violates the correct description of the process, he assumed that the heat flux described by this member runs backwards into the hot region (just zoned the sum of two streams that did not know how to describe) [3] And only now, at the nano-level, where this sum of the flows is not at all zero, it took a lot of effort to "resolve" the local thermo-EMF, which was forbidden by it [4].

So, reflecting only fundamentally new, hardened calculations, and Einstein. But the developers of the Theory of Relativity — the "bare" theorists — did not care about Einstein's "trifles" in its fundamentals as imaginary and harmony, and they very "succeeded" in formally expanding TO by introducing as many additional dimensions as possible. systems of equations. At the same time, they didn't try to "try on the tongue" to enter a single "new" dimension (from 10 to 22), and they modestly kept silent about the infinite number of 4-dimensional sections of their expanded space, giving the TRUE one to draw. This is the bad infinity of solutions of abstract equations unrelated to reality [1]. And it stems from the elementary illiteracy of "prominent" theorists in the field of set theory and the theory of representations. And I think they have not heard about the fundamental possibility of building a strict one-to-one correspondence of the physical space with the abstract using multilinear algebra. This required returning to the basics of building a physical picture of Nature.

In [5], the distortion of the field equipotentials was demonstrated using the simplest example of uniform particle motion, and the excitation of longitudinal gravitational in vacuum was shown without any curvature of the space-time continuum with harmonic oscillation of the particle. Now we will more closely analyze the process of particle acceleration. In this case, we first analyze the distortion of equipotentials in the region where the gradient of the external gravitational field is zero (at Lagrange points between close objects or in a region sufficiently distant from the object). The fact that the potential gradient at these points is zero does not in any way cancel, in accordance with [6], its presence at a given point of the spaces — its absolute value is determined by the corresponding total potential. Consideration of the distortion of the equipotential field distribution is similar to the excitation of a single soliton (tsunami), but we will not carry out a more detailed analysis of the already known solutions of the Sinus-Gordon equation (as was done in [7] with the solutions of the Mathieu equation) base of mathematical process description.

This paper shows that, on the basis of the principle of logarithmic relativity [8], analogies can be used not only to build a planetary model of the atom, but also to find the connection between the gravitational and inertial mass.

2. Real Gravitational Potential

We look at the static interaction (attraction) between the masses. If the field is created by a point mass M located at the origin, the function of the gravitational potential is traditionally given by the formula:

$$\varphi(\vec{r}) = G\frac{M}{r} \tag{1}$$

where G is the gravitational constant, and $\vec{r}$ is the radius vector.

This generally accepted macroscopic Law has no microscopic justification and, as was shown [6], leads to the collapse of the Universe. So it cannot be called either experimentally in a wide range of grounded phenomenological law, or theoretically. And the fact of equality with a very high accuracy of the degree of distance in the denominator of the expression for the strength of the number 2 reflects the Euclidean nature of the three-dimensional physical space of Newtonian mechanics - in three-dimensional Euclidean space the surface area of the sphere is precisely proportional to the square of its radius, but not "force flow" [9].

no one never any particles of the force (field) has been measured, and the accuracy of the experimental checks of the same law of world coordination calibrated by gravity force and, as was was shown in [6], its approximation strongly depends on the accuracy of the determination of the object border.

The most stable state of the infinite Universe (without thermodynamics = time) is given by the following dependence of the potential

$$\varphi_G(\vec{r}) = \frac{M_G}{r^{1.676}} \tag{2}$$

Here we set the gravitational constant for convenience equal to one, and the mass determining the gravitational potential was specifically noted by the index G.

The force of attraction acting in a gravitational field on a material point with a mass m_G is connected with the potential by the formula:

$$F_G = -m_G \cdot \nabla \varphi_G\left(\vec{r}\right) \tag{3}$$

So for the one-dimensional case the force of the gravitational interaction can be written in the following form

$$F_G = -m_G \cdot M_G \cdot \frac{1.676}{x^{2.676}} \tag{4}$$

The gravitational force acting on the control mass m_G tends to zero either at an infinitely large distance, or when striving to zero M_G, creating a potential distribution for the control mass m_G. But, as will be shown below, to determine the inertial force, the own distribution of the potential of the control mass m_G cannot be neglected.

3. TRANSVERSEFORCECAPACITY - GMF

Although the properties of gravitational forces were originally used for the development of ideas about electrical forces, electrostatic representations turned out to be much more advanced than modern gravitational - the properties of electrostatic potential barriers were not only studied for a long time, but also actively used in microelectronics. But even in advanced electrostatic representations, the action of a potential is considered, say, on an electron, which does not determine, in principle, the potential, whereas we need to consider the action of the potential on the particle that formed it. Therefore, in order to build new relativistic representations, we need to carefully analyze the underlying and static models that are implicitly used, like the same Pascal law, in work and transistors. And for a functional justification, it will be necessary to build off not from the traditional record of the Law of the World Genesis (or Coulomb), but from the above gravitational potentials and forces.

When excited and measured, the waves usually take into account only their kinetic energy, although even so they do not always give an account of what kind of object, in fact, this kinetic energy. Just assume a certain mass of water. But the elementary communicating vessels and the Pascal law demonstrate to us that the force acting on the partition is determined by the difference of potential energies, and the total energy and dynamic excitation may include this static part as the determining (main) energy.

The occurrence of a potential (rolling down a hill) force at the boundary of the difference of electrostatic potentials for calculating the EMF in microstructures is a common phenomenon. But to demonstrate its natural occurrence as a gradient of the gravitational potential of the GMF (gravitational driving force - formula 3), and this explanatory scheme shown in Fig. 1 is required, which allows you to more closely "consider" the EMF.

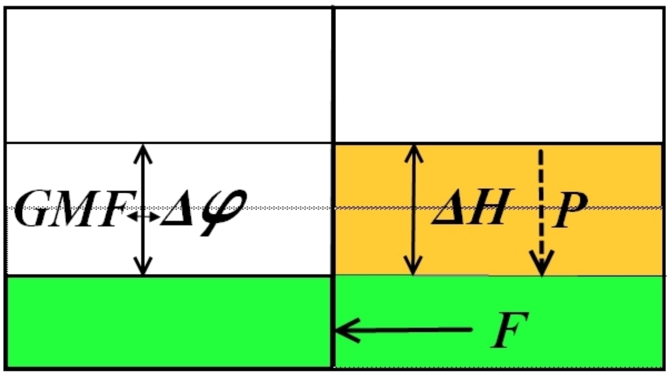

Fig1. *Hydrostatic model of the occurrence of the transverse force of the potential – GMF.*

And so, for gravitational forces, the additional pressure ***P*** determined by the difference of levels ***ΔH*** equals the force F acting on the unit surface of the partition dividing the communicating vessels. So this force (transverse) is simply equal to the difference of water levels on the right and left, i.e. difference equipotentials of the gravitational field $\Delta\varphi$, which is the surface of the water to the left and right of the partition, multiplied by the density of water.

To excite a similar “gravitational anomaly” in the form of a soliton, highlighted in yellow in Fig. 1, if one ignores its impulse, it is required to perform work equal to the difference of equipotentials multiplied by the mass of the soliton.

And for the uniform movement of the “potential feature” shown in Fig. 1, we need to constantly support it. But the kinetic energy of the uniform movement of this feature (a certain mass of water) does not require additional work (its translation does not change the energy, that is, does not require work), and the work of creating a potential feature is determined by the difference between the equipotentials of the water surface before and after partitions. Plus kinetic energy at a constant speed.

When considering such a "gravitational anomaly" in time, it is obvious that it will either dissolve with the transfer of potential energy into the kinetic energy of the waves, or transfer its potential energy to the absorber, such as tank armor.

Above, proceeding from the Principle of the Relativity of Inertial Systems and Pascal's law, we decomposed the energy of the “yellow soliton” into potential and kinetic, which in the non-relativistic case can be represented as follows

$$E_{\Sigma} = \left(\Delta\varphi + \frac{v^2}{2} \right) \cdot M \tag{5}$$

To analyze the shape and properties of a real soliton arising during particle acceleration, we need to consider another “classical” analogy of “creating” again potential energy: compressing a “spring” relative to an infinite Universe, “spring”, which actually gives us the force of inertia F_I

$$F_I = a \cdot m_I = \xi \cdot \infty \tag{6}$$

It follows immediately from the Principle of Relativity of relative motion with constant velocity that the static stiffness of such a spring is zero. But this is a special case reflecting the invariance on speed, whereas already from the invariance of space, the assumptions of a particle moving to infinity, in accordance with f.6, follows an infinitesimal amount of static rigidity. Thus, we have a “spring” with purely dynamic stiffness. And the "spring" without any attenuation (purely reactive resistance when moving in space).

But before we go into the dynamics, we will consider another auxiliary static model that allows us to form a “yellow potential soliton” due to the mentioned rigidity, but not of space, but of a uniform elastic medium. We will get a similar “potential soliton” simply by applying a compressive force perpendicular to the selected section of the elastic medium. At the same time, in the linear approximation (according to Hooke's law) the compressive force is equal to the rigidity of the elastic medium ξ_{El} multiplied by the reduction of its size Δl

$$F = \xi_{El} \cdot \Delta l \tag{7}$$

Such an “alternative” method of “forming a potential soliton” will not only be technically useful for mathematical formalism, but also vividly demonstrates that the potential energy is a scalar, and the direction of force is given in both cases by the direction of the potential gradient, and not by the initial direction of equipotential distribution. Just real, not idealized potential barriers have no infinite gradients, neither electrostatic nor gravitational.

4. LAGEFFECT

When considering dynamic processes in the first approximation, the interaction of gravitational fields can be completely neglected. Although they give an additive contribution to the total gravitational potential, in the dynamics we take into account only the interaction of the particle with its own field. Those.the spatial distribution of the external potential is set equal to the constant. But the fact that the total potential is unambiguously determined by the environment is in some way echoed by the theory of the (fixed) ether. However, the relative motion of an object during this consideration is determined relative to its own field, which initially can be either stationary or move, depending on the background of the object.

If an object shifts in space (for simplicity, consideration is instantaneous), then its own field (position of equipotentials) also shifts, but with a lag time that is equal to the distance of the field in question from the object divided by the speed of light $\delta t = \frac{x}{c}$. . Therefore, as it was shown earlier [5], the equipotentials will thicken in front of an accelerated moving object and stretch behind it.

If the initial position of the center of the object x_0 is set equal to zero, then with its accelerated movement $x_0(t) = \frac{a \cdot t^2}{2}$, the position of the n-equipotential will be shifted -can be described by the formula

$$\varphi_n \to \begin{array}{l} \Delta x_n(t) \approx \pm \frac{a \cdot \left(t - Abs\left[x_n(0)\right]/c\right)^2}{2} \Big/ t \geq Abs\left[x_n(0)\right]/c \\ \Delta x_n(t) = 0 / t \leq Abs\left[x_n(0)\right]/c \end{array} \quad (8)$$

where "+" is in front of the object, and "-" is behind the object.

So, setting the mass of the object, its acceleration and the speed of light equal to one, using formula 2 we can get the change in the distribution of the true potential in time shown in Fig.

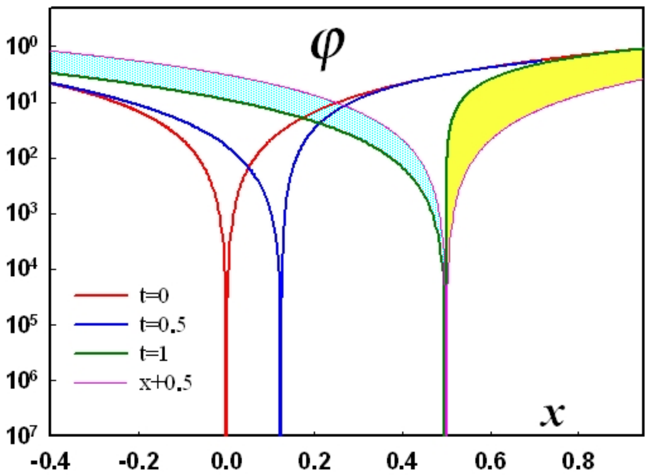

Fig2. *Formation during the accelerated movement of an object of a potential soliton, positive at the leading edge of the object and negative at the rear.*

As shown in Fig.2, the instantaneous movement of the center of the original, symmetric distribution of the potential of a stationary object to the point where it is moved with acceleration gives a great difference from the potential of the accelerated object. The gradient of this, formed due to the acceleration of the potential soliton at the boundary (which strictly coincides with the object), which is determined by the gravitational mass object and gives the restoring force, determined by the inertial mass (formula 6).But as can be seen from fig. 2, such a method for determining the "yellow soliton" contains a large systematic error — we obtain a nonzero difference between the described potentials and beyond the "range of reach" $c\Delta t$.

5. Potential "Gravity Paddle"

To begin with, we use the simplest approximation of the one-dimensional potential distribution of a stationary object: a gentle step — a sharp increase in potential near the object with access to an almost horizontal line.

We also use a visual analogy - paddle paddles on the surface of the water, increasing the water level (and its potential energy) before the oar and lowering the water level (and potential energy) behind the water accelerating oars (Fig. 3).

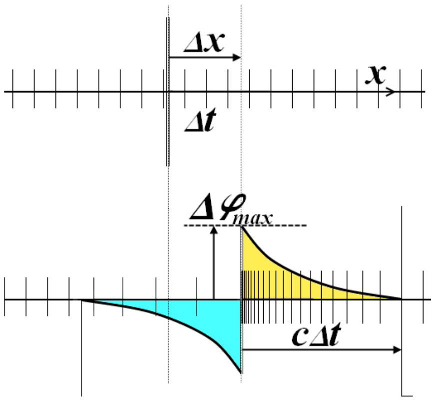

Fig3. *The distortion of the potential surface when the "gravitational paddle" is shifted - dynamic compression / stretching of the equipotonic grid.*

The step noted above, as is used in the macroscopic description of an infinitely thin boundary, abstracts us at least in optics from transient processes at the boundary, even in hydrodynamics, from cavitation and other things. In calculations, the force of the stroke, although the oars, although a screw, are usually neglected by the additive due to a potential soliton. Although, strictly speaking, according to the law of conservation of energy, and his contribution this force must be taken into account. Especially in the energy, the destructive effect of which is obvious during the tsunami, and at least less obvious, but very likely when ships crash during a storm.

But, again, we will not deal with the strict calculation of this pictorial picture for the surface of the water - its refinement is not the goal of this work. We simply use this analogy to describe a perturbation in a gravitational field. Because of caution, since the difference in absolute values of the Coulomb force and gravity is enormous, and we will not consider such a perturbation in the electrostatic potential. Although the fundamental difference in the formation of the relative magnitude of the perturbation with an accelerated displacement of mass and charge is not visible, but the correspondence of inertia to the magnetic field has so far only been demonstrated [5] to qualitatively and formally replace mass in formula 5 with a charge inappropriate. And finally, the “inertia of inertia” - the impulse of a gravitational soliton, focusing on a small impulse of electromagnetic waves, is so far neglected.

And so, as shown in Fig. 3, moving the “paddle” from the initial position (in Fig. 3 above) to a certain final position (in Fig. 3 below) results (as in the case with the water surface as in the communicating vessels of Fig. 1) to the potential difference on the surface: a characteristic increase in potential in front of the oar and a characteristic decrease in potential behind the oar (as in the formation of the potential soliton shown in Fig. 2). The principal difference between the height of the wave crest, which sets the potential on the water surface from the potential of the gravitational field is that for water there is this degree of freedom up and down, and for the potential field this degree of freedom is not, but there is an elastic compression (similar to the soliton described above due to compression of the elastic medium). But the movement of the "paddle", even without acceleration, is associated with the movement of a wave excited in the medium, which is natural to expect in a potential field. But unlike the surface wave on a water surface, the large attenuation of which leads to the deceleration of an abandoned “sliding” pebble, a purely potential wave provides purely reactive resistance. Those.if the action of an external force is terminated, then the distribution of the external potential will return to the original one, shown in Figure 3 above.

Compression / stretching of the gravitational field occurs when the object is accelerated due to the lag effect and corresponds, as shown in Fig. 3, to the change in the density of equipotentials on a gentle step. The height of the potential step, its threshold, is determined by the force opposing the gravitational “oar” in the “macroscopic” model. So a jump in the density of equipotentials on the “gravitational paddle” gives the total (taking into account the sign) the reaction force, which is the force of inertia (formula 6).

It is possible to estimate this force directly on the basis shown in Fig. 2 distortions of the original static gravitational potential, which, of course, is uniquely associated with the gravitational mass and the final velocity of propagation of distortions in it when it is accelerated. But it must be remembered that formula 7 is approximate and is applicable, strictly speaking, for small acceleration times (while the object's displacement Δx is much less than the maximum distortion radius $c\Delta t$), and as noted above, contains a systematic error, the nature of which we will further analyze. In the meantime, we will start from the law of conservation of energy.

For comparison, the inertial mass with gravitational one can equate the kinetic (inertial) energy with a full algebraic increment of the potential energy of the gravitational soliton, or, more simply, equate a positive increment - "yellow soliton" with half the kinetic energy. Since all the potential distortion energy is concentrated in $c\Delta t$, we get the following functional relationship:

$$\frac{1}{c\Delta t}\int_{\Delta x}^{\Delta x+c\Delta t}\Delta\varphi(m_G,x)dx=\frac{1}{2}\frac{m_I v^2}{2} \tag{9}$$

This expression (8), in the approximation used, reflects the identity of the recording of the kinetic energy of mass with the potential soliton of the gravitational field associated with it — its average height in the interval $c\Delta t$. Using formula (7) and subtracting the one shown in fig. 2 (curve ***x+0.5***) the potential is "instantly" displaced from the potential of an object that has reached acceleration to this point (curve ***t=1***), an expression can be obtained that qualitatively characterizes the potential increments:

$$\Delta\varphi(m_G,x)\approx\varphi(m_G,x-\Delta x(t))-\varphi(m_G,x+\Delta x(0)) \tag{10}$$

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$$\Delta\varphi(m_G,x)\approx\varphi(m_G,x-\Delta x(t))-\varphi(m_G,x+\Delta x(0)) \tag{11}$$

This method of calculating the "yellow soliton" (Fig. 2, 3), as already noted above, is also noted in the note to Fig. 2, and as can be seen from the precision numerical calculation with an interval of time less than the maximum allowable - $\Delta t = 0.2$ (Fig. 4), contains a systematic error (pic.5).

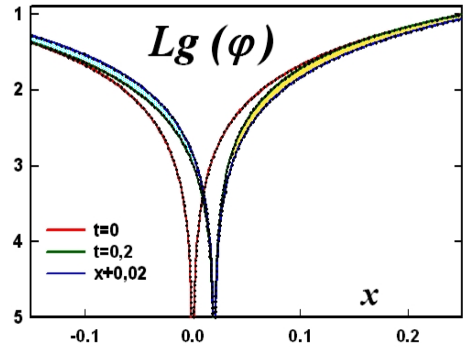

Fig4. *The formation of a "yellow soliton" of the gravitational field with the accelerated movement of the object.*

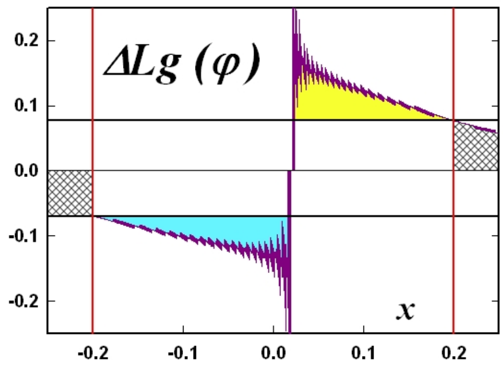

Fig5. *The error in determining the amplitude and duration of the "yellow and" blue "soliton (shaded areas) according to formulas 7 and 9.*

The non-physical potential shift observed at Fig. 5 and at infinity can be corrected by performing a numerical calculation of its displacement, providing zero value of the “yellow soliton” on the border of the “reach region” Thus, the resulting functional relationship

$$\frac{1}{c\Delta t}\int_{\Delta x}^{\Delta x+c\Delta t}\Delta\varphi\left(m_G, x\pm\frac{a\cdot\left(t-Abs\left[x\right]/c\right)^2}{2}\right)dx \square \frac{1}{2}\frac{m_I\left(a\Delta t\right)^2}{2} \qquad (12)$$

The resulting functional relationship is not strict. But, first, it allows to obtain a qualitative confirmation of the interdependence of the gravitational and inertial masses. And most importantly, using the explicit form of the true potential (formula 2), we can also obtain rigorous quantitative estimates, which, as can be seen from the expression below, DEPEND on acceleration and acceleration time

$$\frac{m_I}{m_G}\square\frac{4}{a^2\cdot c\Delta t^3}\int_{\frac{a\cdot\Delta t2}{2}}^{\frac{a\cdot\Delta t2}{2}+c\Delta t}\left[\frac{1}{Abs\left[x\pm\frac{a\cdot\left(\Delta t-Abs\left[x\right]/c\right)^2}{2}\right]}\right]^{1.676}dx \qquad (13)$$

6. Conclusion

The unique feeling of connections in Nature allowed such Geniuses as Tesla and Termen to create fundamentally new devices that expanded the range of human senses, allowed them to create them, even bypassing the formalization of even the principles on which devices and even devices were built.

The principles and postulates introduced by such Coryphaeus as Einstein and Ioffe have become the bridge to a fundamentally new conscious knowledge, to the construction of the Theories. But science will turn into a set of kaleidoscopic pictures, if the process of understanding the basic fundamentals and their contradictions with newly discovered phenomena stops. And if the impetus to rethink the Law of the World (the article "The Schottky Effect and the Cosmos") was the story of the American astronaut Neil Armstrong that they would not return from the moon to the Earth, then the impetus for this work was the observation of the Russian cosmonaut Dzhanibekov : “A box that“ freely clings to something ”that rotates freely in weightlessness at the station and regularly changes the direction of rotation to the opposite. And this "something" was stronger than the breath of air. " Formally, a typical soliton was observed with a divergence of two phases (and not with a change in amplitudes). And only the phase of rotation of the box and the phase of rotation of the station relative to the Earth changed. Phasefieldswerechanging.

It is here that this “something” is analyzed - the distortion of the gravitational field, which does not require any additional dimensions, and it is REQUIRED to correctly understand the Principle of Relativity - opposition to the acceleration of an object arises due to its shift in the relative potential field. And such a description of inertia shows that the principle of equivalence of gravitational and inertial mass, laid down by Einstein into the Theory of Relativity, itself breaks down when approaching the speed of light. And in abstract cosmological pictures, the range of applicability of the Einstein corrections to energy is attempted to be “extended” by multidimensionality.

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