Nature of Inertia forces

Yu. A. Baurov

Closed Joint Stock Company, Research Institute of Cosmic Physics, 141070,
Moscow region, Pionerskaya 4, Korolyov, Russia

E-mail address: baurov@mail.ru

ABSTRACT

The physical nature of inertia forces is shown on the base of theory of byuons, the theory of "life' of special unobservable discrete objects – byuons from which the surrounding physical space (dark matter) and the world of elementary particles are formed. The theory of byuons predicts a new non-gauge force of nature which explains of physical nature of inertia forces.

Keywords: byuon; new force; inertia forces

1. INTRODUCTION

It is known [1] that standard model of modern physics the inertia forces (F_i) has not real physical (active) forces. These forces have directions against of particle acceleration direction gave by active force. For simplification study of object dynamics the researchers use the D'Alembert's principle which reduce the dynamics to statics and decide to research of motion relatively of coordinate inertia system using F_i. It is note the physical space is always given in all the science, in one way or another, and motion equations for a system of objects under study are written in that space.

Space could be uniform continuum (Newton, Minkovsky) or discrete, one-dimensional or multidimensional [2,3], asf. In present-day cosmologic models of the Universe origin (Gamov's Big Bang [4], Linde's model of bulging Universe [5], and so on), space is always given, too.

In this article author using theory of byuons [6-8] shall show that F_i is production of physical space giving. The theory of byuons is non gauge theory of "life" of special unobservable discrete objects – byuons from which the surrounding space and the world of ultimate particles form.

The description of the essential distinctions of the byuon theory from modern models in the classical and quantum theories of field reader can find in [6]. For understanding of nature of F_i author propose to consider the new physics of all forces of nature using the theory of byuon and new principle of relativity in physics [6].

2. ABOUT UNIFIED WAY OF UNDERSTANDING OF EXISTING INTERACTIONS. FORCE-FREE PHYSICS. PRINCIPLE OF RELATIVITY

Without denying present approaches to constructing a unified theory of interactions, based on advances in gauge theories, supersymmetric and superstring models [9-14], let us attempt to outline a new method of attacking this old problem existing since the days of A. Einstein, by means of theory of byuon [6,7].

Let's remind a basic hypothesis 1:

Assume the observable three-dimensional space R_3 to appear as a result of minimization of the potential energy (E(i)) of byuons interaction in the one-dimensional space R_1 formed by them. More precisely, the space R_3 is fixed by us as the result of this byuons dynamics. In the space R_3 therewith the dynamic processes for objects with the residual positive potential energy of byuons interactions originate, and in consequence, the wave properties of elementary particles arise.

The main idea is that all the existing interactions (electromagnetic, gravitational, strong, and weak) as well as the new interaction predicted by the author and described in [6-8], are reduced to dynamics of the system of interacting byuons: changes in their periods of interaction (i.e. $x_0 = k \ \tilde{x}_0 \approx 10^{-17}$ cm and $ct^* = kN \tilde{x}_0 \approx 10^{-13}$ cm ; k and N- periods of byuons interaction; $\tilde{x}_0 \approx 2.8 \cdot 10^{-33}$ cm - the quantum of space) and in the functions $cos^{i,i-k}_{II^+,II^+}$ $cos^{NkP-i,NkP-i-k}_{II^-,II^-}$ etc., minimizing potential energy of byuon interaction in corresponding vacuum states (VSs: II^+, Γ^+, Γ^-, II^- depending on whether the expression for

byuon $\quad \boldsymbol{\Phi}(i) = \begin{cases} [\mathbf{A}_g x(i)], \\ -\sqrt{-1}[\mathbf{A}_g x(i)] \end{cases}$

is real or imaginary, its length x(i) positive (II^+, Γ^+,) or negative (Γ^-, II^-), decreases (Γ^+, Γ^-) or increases (II^+, II^-) in modulus) and leading to appearance of spin quantum number for quantized objects or angular momentum for classic objects (the index $i = 0,1,2,…k,…$; $\mathbf{A_g}$- the cosmological vector-potential, a novel fundamental vectorial constant, $A_g \approx 1.95 \cdot 10^{11}$ Gs·cm)

What usually sees an observer while investigating such or another interaction between objects? He sees motion of objects which approach each other or are moving apart, or rotate relative to each other at the same distance. For example, objects are attracted together by gravity and can repel one another by electric interaction (two electrons, for instance). When objects of the nature rotate (for example, the Larmor rotation of an electron in a magnetic field, rotation of planets around the Sun, proper rotations of objects etc.) the distances between them are constant. In terms of the forces, these phenomena can be described by the Newton's law of gravitation, Coulomb's law, Lorentz force etc. But there exists also another approach basing on change in periods of byuon interaction and in functions of $cos^{i,i-k}_{II^+,II^+}$ type. In this way one can describe all the existing interactions without using the idea of "force".

This notion is closely connected with that of "field". Give an extract on this subject from Ref. [15]:

"The interaction between particles can be described using the concept of a force field. Rather than tell about an action of one particle on another, one may say that the particle creates a field around itself and that a force acts on other particle being in this field. In classical mechanics the field is only a method of describing the physical phenomenon, interaction of the particles. But in theory of relativity the situation is sufficiently different owing to finiteness of interaction velocity. The forces acting on the particle at the moment are not determined by position of other particles, and a change in position of one particle has an effect on the others only after some time. That is, the field becomes a physical reality by itself. One may not tell about a direct interaction of separated particles, this interaction can occur at each instant of time only between neighboring points of space (short-range interaction). Therefore we should say about the interaction of a particle with a field and the following interaction of the field with another particle".

In our approach (see theory of byuon [6,7]) the concept of field is not necessary since dynamics of the observable object can be explained due to that of a finite set of byuons connected between themselves in R_3 through an uncertainty interval *4b* of objects (object formed during four-contact byuon-byuon interaction in VSs II^+ I^+ I^- II^- (to read as "4b-object", $mc^2_{4b} = 33$ eV; c- speed of light)) or, in other words, through a change in physical space structure. Show that qualitatively for the existing types of interactions.

2. 1. About strong interaction

The nuclear forces (and other types of strong interactions) are introduced by means of Yukawa potential, quantum chromodynamics (QCD) or other field theories, when putting their assumed field structures into a given space. It was shown in [6] that the strong interactions can be qualitatively explained on the base of process of charge formation (PCF) of second type producing two electric charge opposite in sign and with magnitude so much larger than the elementary charge e_0 that the constants of interaction become close to *1*. It is seen from the formula showed in [6] that the greater energy *E* of hadrons, the greater the value of charges of a pair.

It was assumed in [6] that spinor and boson properties of material fields are more fundamental than their charge numbers being formed due to transitions between the vacuum states of these fields II^+, I^+, I^-, II^- and revealing, in the process of their formation, some loop structure of the vectorial potential $\vec{A}$ which is identified by us now with the total potential $\mathbf{A_\Sigma}(|\mathbf{A_\Sigma}| \leq |\mathbf{A_g}|$ entering into interacting byuons. Note that basing on the information theorem given in [6-8] it is principally possible to approach the origin of statistical properties of field structures observable in nature.

The major difference between the boson and spinor fields consists in the fact that when the coordinate space is turned through 2π around some axis, the boson fields "track" this turn and rotate through 2π, too, but spinor fields do only through π [16], which corresponds to *h*- and *h/2*-action, respectively, while minimizing interaction of byuons. Hence depending on ratio of complexities of information images S_1/S_3 (index *1* correspond R_1; index *3* correspond R_3) we can have objects with a half-integer or integer spin in R_3. (In fact, the ratio S_1/S_3 tells here about the number k of periods in an observable object in R_3, about its even (bosons) or odd (spinors) value. Bosons have always an even number of loops: a loop in the world *(x> 0)* and a loop in the antiworld *(x < 0)*. Spinors have always an odd number of loops, i.e. one "loop" has no conjugate "antiloop").

It is shown in [6-8] that when dynamics of byuon interaction [$\vec{A}_G x(i)$] in vacuum states II^+ or II^- is investigated, three points "0", "1", and "2" for index *i* appear with necessity,

which causes three-dimensionality of the observable space R_3. Now we may argue that the three assumed directions ξ, η, ζ (see [6 - 8]) in the space M_I [6], randomly coinciding with arbitrary directions in M_{III} [6], are in fact three independent directions corresponding to starts from "0", "1", and "2", for instance, in index i for byuons being in the vacuum states II^+ and II^-. While counting an arbitrary byuon index, the starts "0", "1", and "2" indicate color of an object in R_3, formed by them (in terms of QCD).

One can also show that the interaction of two charges opposite in sign leads to reducing periods of byuon interaction, i.e. to attraction of them. (See below "Electric field. The most simple case").

In strong interactions separation of pair charges cannot be more than the period of byuon interaction equal to *kN (ct* * *~ 10*$^{-13}$ *cm)* since the following period of interaction equals *kNP (~ 10*^{28} *cm)*. It is a reply for hypothesis of "confinement of quarks".

2. 2. About weak interaction

It is shown in [6,17] that to explain the weak interactions it is not necessary to introduce the Pauli's hypothesis on existence of neutrino. The laws of conservation are taken over by the physical space structure formed from the object *4b*.

Now, when we can calculate periods of byuon interaction, x_0 and ct^*, from its minimum potential energy, the constants of weak interactions can be entirely obtained by formulae in [6].The essence of weak interactions is presented correctly in [6,17] as consisting in extending the process of charge formation in R_3 - space the minimum over two minimum periods of byuon interaction i.e. over *2x$_0$*. Using this physics in [6] it is showed the mass formulae for all the well known leptons and in [17] mass of next lepton too.

2. 3. About electromagnetic and gravitational interactions

It should be noted that the works by H. Weyl [18,19] and P. Dirac [20] are the nearest to our new approach to searching a single pattern of the world. The basic ideas of H. Weyl and P. Dirac are well presented in the book [21] too.

Historically, the Weil's geometry was proposed for explaining by curvature of space not only the long-range gravitational field as in the theory of Einstein but another long-range field, the electromagnetic field, too.

Gravity experiments are well explained by the Einstein's theory in terms of space curvature. This suggests that the electromagnetic field also can be attributed to a certain space property instead of considering this field as simply "immersed" in space. Thus, some more general space than the Riemannean space underlying the Einstein's theory, had to be proposed to describe the existence of either gravitational or electromagnetic forces and to unify the long-range interactions.

The curvature of space required by the Einstein's theory can be represented in terms of parallel displacement of a vector moving along a closed contour, which leads to the effect that the final direction of the vector will not be the same as the former. The Weil's generalization was in assuming that the final vector has not only a different direction but a different length, too (and this is the most important thing). In the Weil's geometry, there is no absolute procedure of comparing elements of length at two different points if these are not infinitely close to each other.

The comparison may be made only relative to a line segment connecting the two points, and different ways will give different results as to ratio of the two elements of length. In order to have mathematical theory of lengths one must arbitrarily establish a length standard at each

point and then relate any length at anyone point to the local standard for this point. Then we will have a fixed value of the vector length at any point but this value varies with the local standard of length.

Consider a vector of length l positioned at a point with coordinates x^μ ($\mu = 1, 2, 3, 4$). Assume that this vector is transferred to the point $x^\mu + \delta^\mu$. The change in its length δl will be proportional to l and δx^μ so that $\delta l = l\, k_\mu\, \delta x^\mu$ where k_μ is additional parameters of the field appearing in the theory together with the Einsteinean $g_{\mu\nu}$ and being equally fundamental.

Assume that the length standards have been changed so that lengths are multiplied by a coefficient $\lambda(x)$. Then l goes into $l' = l\lambda(x)$ and $l + \delta l$ does into

$$l' + \delta l' = (l + \delta l)\lambda(x + \delta x) = (l + \delta l)\lambda(x) + l\frac{\partial \lambda}{\partial x^\mu}\, \delta x^\mu.$$

Hence

$$\delta l' = \lambda \delta l + l\frac{\partial \lambda}{\partial x^\mu}\, \delta x^\mu = \lambda l\left(k_\mu + \frac{\partial lg\, \lambda}{\partial x^\mu}\right)\delta x^\mu.$$

Thus, $\delta l' = l' k'_\mu \delta x^\mu$, where

$$k'_\mu = k_\mu + \frac{\partial lg\, \lambda}{\partial x^\mu}\ . \tag{1}$$

If our vector is transferred by parallel displacement along a closed contour, a change in its length will be $\delta l = lH_{\mu\nu}\delta S^{\mu\nu}$, where $H_{\mu\nu} = \partial k_\mu/\partial x^\nu - \partial k_\nu/\partial x^\mu$, and $\delta S^{\mu\nu}$ denotes an element of area limited by a small contour.

Show that the new field characteristic k_μ appearing in the Weil's theory has the meaning of electromagnetic potentials. As is known [15], the antisymmetric tensor $F_{\mu\nu}$ of the electromagnetic field has the form $F_{\mu\nu} = \partial A_\mu/\partial x^\nu - \partial A_\nu/\partial x^\mu$ where A_μ and A_ν are components of the real covariant four-vectorial electromagnetic potential. Comparing the $H_{\mu\nu}$ and $F_{\mu\nu}$ tensors we see that, indeed, the additional parameters characterizing proportionality of change in length of the vector l while going from the point x^μ to the point $x^\mu + \partial x^\mu$, have the meaning of electromagnetic potentials. They go through the transformations (1) corresponding not to a change in geometry but only to a change in choosing artificial length standards. The derivatives $H_{\mu\nu}$ have a geometrical meaning without regard to standards of length and correspond to physically significant parameters, electric and magnetic fields. Thus, the geometry of Weil assures just what is necessary for describing the gravitational and electromagnetic fields in terms of geometry.

Hence when assuming a mathematical algorithm of transition of events from R_1 to R_3 as having been found, the electromagnetic and gravitational interaction of objects can be assured by changing period of byuon interactions K, N and scale lengths x_0 and ct^*, respectively. The electromagnetic field is caused therewith by changing $|\vec{A}_\Sigma|$ due to some scalar A_0, and magnetic field is due to a vectorial potential $\vec{A}_1$ but with the complete return of the vector $\vec{A}$ to the initial point of the R_3 - space while tracing some closed contour l (in this case $cos_{II+II+} =$

$cos_{II-II} = 0$). Note once more that the electromagnetic constant of interaction (constant of fine structure) $e^2/\hbar c$ will be constant in all reference systems [6,7].

2. 4. The new interaction, the new principle of universal propulsion and nature of inertia

According to the theory of byuon a fraction of the mass of the elementary particles, associated with the formation of their inner physical space and up to the value $\Delta m \cdot c^2 = 33$ eV in value, is proportional to the modulus of a summary potential A_Σ, i.e. the sum of the potentials of all known force fields calculated using the energy relation expressed in [22]. We pointed above such summary potential cannot exceed, by magnitude, the modulus of the cosmological vectorial potential **A_g.**

As the result of the action of the field potentials (decreasing $|A_\Sigma|$), each particle gains an energy $\Delta m \cdot c^2$ that corresponds to a new force of nature throwing substance out of the region with the weakened A_Σ. Experimental investigations with the use of gravimeters [6, 7] and magnets and plasma systems [23], as well as the measurements of changes in the β-decay rate of radioactive elements [6,7,24,25], that were later confirmed by independent researches [26], have shown that the substance is ejected from the region with the weakened A_Σ along a cone with an angular opening about 100° around the vector determining the global anisotropy of the physical space (vector **A_g**) and having the following astronomical coordinates in the second equatorial system: $\alpha \approx 293° \pm 10°$, $\delta \approx 36° \pm 10°$ where α is the right ascension and δ is the declination, the former value being later updated to the following: $\alpha = 300° \pm 10°$ [27].

The analysis of a long run of experiments has shown that the new force has a nonlinear and nonlocal character and can be represented as a complex series in terms of changes of the summary potential A_Σ. The first term of the series is the following:

$$F = 2Nm_v c^2 \lambda_1^2 \Delta A_\Sigma [\Delta(\Delta A_\Sigma)/\Delta x] \qquad (2)$$

where N is the number of stable particles (electrons, protons, and neutrons) in the test body, ΔA_Σ is the difference in changes of the summary potential A_Σ at the location points of a test body and sensor element, $\Delta(\Delta A_\Sigma)/\Delta x$ is the gradient in space of the difference potentials ΔA_Σ; x is the length of an arc of a circle for experiments with solenoids, therefore a space coordinate; $2m_v c^2 = 33$ eV; $\lambda_1 = 10^{-6}$ (Tm)$^{-1}$ is the first coefficient of the series.

In [28] the origin of the dark energy of the Universe (about 70 % of total energy) is explained on the basis of the changes of the summary potential of A_Σ by means of the repulsion of the galaxies which in turn reduces the module of A_Σ by means of their own gravitational potentials.

Moreover, the mutual repulsion and acceleration of the galaxies is explained in the same work under the theory of byuon, starting from the interaction of two galaxies, each of which containing 10^{10} stars, assuming that the mass of each star is of the order of the solar mass (10^{30} kg) and the relative velocity of each galaxy is v = 100 km/s or v = 1000 km/s: the distance R_{GG} at which the new force predicted by the theory of byuon will be greater than the gravitational force results as follows: $R_{GG} \geq 10^{24}$ m for v = 100 km/s, and $R_{GG} \geq 10^{26}$ m for v = 1000 km/s.

As anticipated above, the fundamental research of the global anisotropy of physical space along with the basics of the byuon theory based upon such anisotropy as well as all the relevant bibliography is summarized in [27].

The new force can be used for realization of traction force.

The new principle of universal propulsion, i.e. traction force applicable to any object in any surrounding medium, is based upon the role of the *physical space as an environment supporting the motion of an object*; the physical space is to be meant as a quantum medium filled with "hot" and "cold" dark matter in the framework of the theory of byuon [6-8]. Therefore, it is possible to figure out some new universal class of thrusters able to move any object in any environment, e.g. under the water, on the water and through the air, as well as in the cosmic space, because it will exchange momentum neither with any ordinary substance, nor with any substance ejected from the object itself such as exhaust gases or ionized particles: the momentum exchange will occur with the physical space that in the theory of byuon is not just some mathematical fiction, rather a physical object which density of matter without ordinary substance is around 10^{-29} g/cm^3 ("cold" dark matter). Close to any usual material bodies, the density of matter is much larger ("warm" dark matter). No need to say that the resulting propulsion, even if based upon a new kind of momentum exchange, must obey Newton's third law of motion.

Any material body can only decrease the summary potential A_Σ by means of the whole set of its physical potentials [29]: in the physical space a sort of "potential hole" arises with a reduced module of A_Σ that will be indicated as the Information Object (IO) of the given body in the physical space. The reality of the IO was investigated for the first time by means of experiments with a physical pendulum, earlier described in [29];

The upper value of the traction force can be estimated replacing the quantities in (2) [30] with the appropriate numbers; given the mass equal to 526 g and material, i.e. iron, of the off-center load of revolution we have: $N \approx 10^{26}$ and, according to [7-9]:

$$\Delta A_\Sigma = \Delta(\Delta A_\Sigma), \quad \Delta A_\Sigma = A_g \cdot \cos{}_{\text{II}}{}^{+}{}_{\text{I}}{}^{+} \cdot c/v, \quad \cos{}_{\text{II}}{}^{+}{}_{\text{I}}{}^{+} = 10^{-15},$$

where c is the speed of light, $v = \Delta x/\Delta t = 0.02$ m/s is the extinction velocity of the IO, where Δx is the characteristic size of the body of revolution, i.e. around 2 cm in the performed experiments, and Δt is the extinction time of the IO, on the order of 1 s as stated in [29]. Substituting into (2), the upper limit of the traction force can therefore be estimated on the order of 1 N.

The experimental results [30] show the value of the traction force is equal (10-50) g if mass of body about 500 g, period of revolution about 0.1 c, radius of revolution about 10 cm, characteristic size of the body about: diameter 2 cm, length 10 cm. An arising of IO require of retaining time in stop position more 0.05 c

The diagram of an arising of inertia force is showed in Fig. 1. The physics of any inertia force is connected with arising of inner physical space ultimate particle and of charges numbers [6,7]: spin, electric charge, mass etc. But if we use a conception of force then we can explain the nature of inertia force using the nature of new force because the nature of new force connected with arising of inner physical space ultimate particle and charges numbers.

In Fig. 1 it is showed that a new force repulse the body from place of IO created by stop position of body because $\Delta A_\Sigma < 0$ in this place. But new force will retain the body in place of stop position always because the value of gradient $\Delta(\Delta A_\Sigma)/\Delta x$ has other sign in stop position than the sign when the body is approached to IO outside.

The retaining of body in stop position using of new force is inertia condition of body in framework of byuon theory.
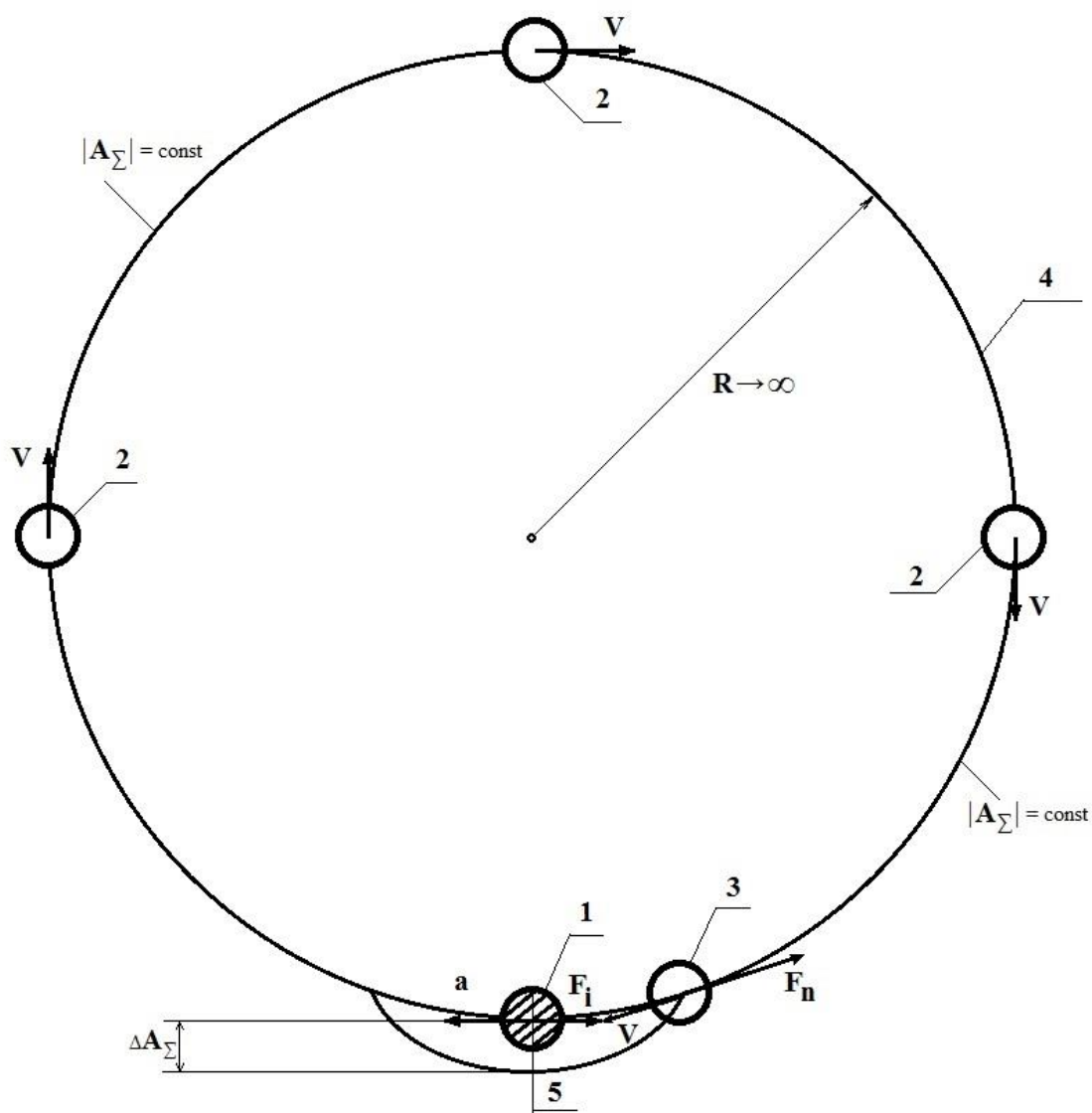
Fig. 1. A diagram of inertia forces physics.
1 – The body in stop position; 2- the position of body in process of motion with speed **V** in space with
A_Σ = const; 3 – position of body near of IO after caming back; 4 – trajectory of body motion with
radius R $\to \infty$; **a**- acceleration of body in first moment of motion (5); F_i – force of inertia; F_n – new
force; ΔA_Σ – change of A_Σ in place of body stop position.

2. 5. The principle of relativity

The physical nature of inertia forces requires a creation of the new principle relativity.

The phenomenon considered the new interaction is nonlinear and nonlocal. Penetration
into its nature and in the nature of other interactions connected with a change in fundamental
scales leads to a force-free describing the movement of environmental objects and prompts us
to improving the principle of relativity.

According to the Galilean principle of relativity [15], all the laws of nature are the same
in all inertial coordinate systems or, to be more specific, the expressions for the laws of nature

are invariant relative to transformation of coordinates and time when going from one inertial coordinate system to another.

The complete invariance of all inertial reference systems is indicative of absence of anyone "absolute" coordinate system. That is the essence of relativity of phenomena.

In mechanics of Galileo, the velocity of propagation of interactions is infinite and time is absolute, i.e. independent of reference system.

Basing on the experiments of Michelson (of 1881) having shown independence of light speed of its direction of propagation, Poincare and Einstein has developed the principle of relativity, supplementing it with a postulate of finiteness of velocity of interactions. According to the principle of relativity, this velocity is the same in all inertial reference systems and equal to light speed c_0.

The limitation on the velocity of interactions has led to a situation when time ceased to be absolute and became dependent on a reference system, and the transformation laws from one inertial coordinate system to another acquired non-Galilean form of Lorentz's transformations.

What the new contributes the new approach to R_3 formation from the one-dimensional objects, byuons (in accordance with the hypothesis 1 and [6,7]) to the relativity of events in R_3?

In order to answer this question, it should be reminded once more what is generally a coordinate system in our sense and what we will name as an inertial coordinate system.

If we put a question of how the observable physical space is built, we cannot already arithmetize "emptiness" as this is done in classical physics, quantum mechanics, quantum field theory etc. We may only find, with some accuracy, coordinates of some observable physical objects relative to other ones.

Hence just therein the notion of coordinate system loses its uniqueness. Further, if we do determine the position of observed objects relative to each other with some accuracy from the viewpoint of large-scale world, we can arrive at the concept of the inertial coordinate system, too. By inertial systems of coordinates we will mean such systems in which periods of byuon interactions k,N,P (or scale lengths x_0, ct^*, ($\tilde{x}_0 kNP$)), as well as the functions of cos_{II+II+}, cos_{II-II-} type are the same. This statement is fulfilled always within some accuracy. In such systems of coordinates the observable laws of nature will be the same to some precision. Therein just lies the basic idea of expanding the concept of relativity. Therefore in experiments of subsection in [6, 7] on investigating the new force, using a balance, the weight was always suspended to a cantilever if only *1cm* in length since otherwise (when a test body and the sensor are in regions of similar dimensions x_0) the new force will be zero.

3. CONCLUSION

It is show the retaining of body in stop position using of new force is inertia property of body (inertia force) in framework of byuon theory.

The force-free description of motion of objects gives an intimate understanding of nature but the stereotype of our mentality and an exactness of describing motion of objects on the base of the second Newton's law, quite sufficient for an ordinary way of life, leads us to the concept of the new force and inertia force though physically this is only a change in scale lengths.

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