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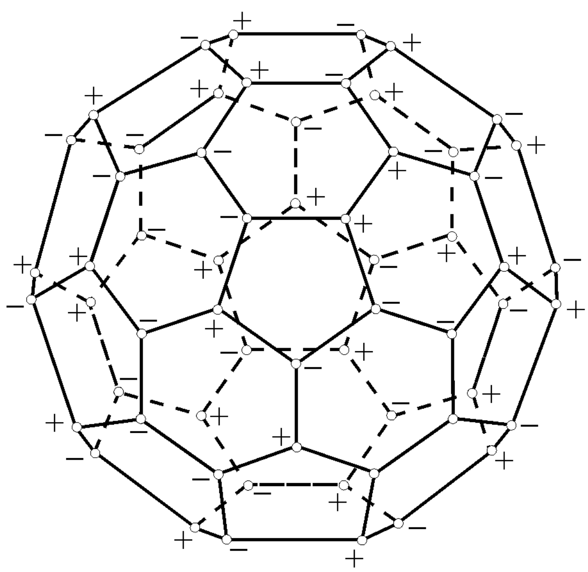

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THE MODERN CONCEPTS OF SPACE, TIME, AND BOUNDEDNESS OF LORENTZ TRANSFORMATIONS

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October 2, 2002

The modern analysis of space and time concepts is given. It is shown that their deformation at material bodies motion regarding each other has interrelated character, and the Lorentz transformations describe this deformation correctly only in the cross to plane the motion direction. The author offers the group of coordinates affine transformations in absolute symmetric 6-dimensional space-time, which maintains the light cone equation without change and describes this deformation correctly instead of Lorentz transformations. The author uses this transformation group successfully since 1984 that so the problem of the Lorentz transformations and the Einstein's Special Relativity together with them should be refused currently.

1. Introduction

Lorentz transformations will be 100 years in 2004. These transformations are the basis of all modern physical theories related to space and time. The Einstein's Special Relativity (SR), which was created a year later, is based completely on these transformations. These transformations were introduced into the General Relativity (GR) which was created by Einstein in 1915, though they are not interior attribute of this theory. They became a part of all subsequent theories and still go on being considered as the truth criteria and a keystone of the whole modern physics.

But it would be desirable to ask after the expiry of almost 100 years whether the indicated coordinate transformations of space and time correspond to real nature indeed? If there is no mistake here which delayed the physics development for 100 years totally and goes on delaying nowadays?

The detailed analysis of modern definitions of the space and time units, carried out by the author in 2002, has shown that Lorentz transformations contradict them radically and, hence, cannot be used in physics further without damaging its progress. What should be used instead of Lorentz transformations?

It turns out, that there is an alternative. The author has been using other coordinate transformations [1] instead of Lorentz transformations since 1984 that allowed him to develop new consistent model of the stationary nonexpanding Universe and receive a series of the most interesting results in the cosmology [2], such as, for example:

— the identity proof of inertial and gravitational mass according to the Mach's principle;

— the discovery of gravitational viscosity and geodetic curvature of the Universe;

— the property detection of the substance gravitational screening, etc.

Today, being on a threshold of the centenary anniversaries celebrating of the fundamental creation in modern physics it would not be out of place to look into this fundamental again, whether we operate correctly with space and time at transition from the fixed object to moving one, from one inertial reference system to another. And it ought to be comprehended once again, what we should mean by the concepts "space" and "time."

2. The space and time concept

The space and time are the categories, which designate the basic existence forms of all substance kinds from the philosophical point of view. The space expresses the existence order of separate objects; the time expresses the order of phenomena change [3].

The length is the space measure, which characterizes extension, remoteness and movement of bodies or their parts along the given line. Time characterizes the sequential phenomena and states the substance change and the duration of their being [4] as well.

Let's specify the modern definitions of the length and time units (meter and second) without going into the definition history and characteristics of various physical unity systems. We shall start with a second as this unity has received its modern definition earlier,

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than the meter.

The development of the molecular and atomic spectrum analysis has enabled to connect the time units with oscillation period precisely enough, which correspond to a spectral line of any element. Therefore according to the solution of XIII-th General Conference of weights and measures (1967) the second definition has been given, which acts till now according to which **the second has the duration of 9.192.631.770 radiation periods, which corresponds to the transition between two superfine levels of the basic state of cesium atom – 133** [5]. Hence, the number of periods, mentioned above, will be equal to cesium radiation frequency – 133, which we shall designate as ω_C for further use.

The measuring precision increase has allowed connecting the length unity (meter) with the wavelength of a certain spectral line as well. The orange line of the krypton – 86 has been accepted as such a line. This line corresponds to the electron transition in the krypton atom between quantum states, which are designated by symbols $2p_{10}$ and $5d_S$ in a spectroscopy. According to the definition, which was accepted at XI-th General Conference of weights and measures (1960), the meter contained 1650763.73 of the wavelength in this spectral line vacuum.

However the further achievements of laser technique, quantum electronics and high accuracy, which managed to be achieved at the light velocity measuring, have allowed connecting the definition of the length unit (meter) with the time unit (second) together. And XVII-th General Conference of weights and measures (1983) adopted a resolution to define the meter, as: **the meter is the distance, which the flat electromagnetic wave transits in vacuum for 1/299792458 seconds**, which acts till nowadays. The light velocity value at such meter definition is accepted as the value which is not subjected to the improvement, i.e. it is precisely equal to 299.792.458 m/s.

Thus, the second is the duration of the particular number of the cesium radiation periods – 133, and the meter is the particular distance which the electromagnetic wave transits. But it is not forbidden to use the same electromagnetic radiation for the meter definition, as for the second definition. Therefore let's use radiation for reasoning simplifications further, which corresponds to the transition between two superfine levels of cesium – 133 atom basic state.

The equivalent ratio is easily composed of two effective definitions of the meter, second and agreement accepted above. So, it appears from the second definition that the wavelength of cesium – 133 radiation, mentioned above, is equal to

$$\lambda_C = \frac{c}{\omega_C} = \frac{299792458}{9192631770} = 0.0326122557\,\mathrm{m}, \qquad (1)$$

and the meter, accordingly, will have the length

$$1\ \mathrm{m} = \frac{1}{\lambda_C}\lambda_C = 30.66331899 \cdot \lambda_C. \qquad (2)$$

We also came to the conclusion, that one meter is equal to 30.66331899 of radiation wave lengths, which corresponds to transition between two superfine levels of cesium – 133 basic state atoms that is analogous to the meter definition given by XI-th General Conference of weights and measures (1960). If we take other radiation source we shall receive other number. And cesium – 133 is chosen due to the reasons, that its frequency is very stable.

Now it should be told about the author's imagination of time. But at first the popular expression should be reminded, which is used among businessmen more often: "time is money". And so, the money plays a role of a universal equivalent in a society by means of which there is an exchange of goods and services. And money, which has been invested into business, makes profit, i.e. new money. The saying, mentioned above, follows from here.

But, probably, few modern physicists (and businessmen especially) paid attention to other link between money and time, which bases on the use analogue. Strangely enough, ancient philosophers were informed better about it, than we are informed now. Moreover the author of the works [6, 7] has suggested measuring time in units of masses (kilograms, grams, pounds, ounces, etc.).

And now I give the author's definition of time: **time is a universal equivalent by means of which juxtaposition (comparison) of various processes velocity passing is performed. The concept of time is senseless outside of these processes** [8]. The year, month, hour, minute can be used as the equivalents, and the second is used as the equivalent in physics in International System of Units (SI). If it is not inconvenient also (for processes which flow very fast, for example), so the millisecond, microsecond or other small interval of time as the part of the standard equivalent are used for the processes comparison.

The processes cannot flow differently as by the position change (travel, an overflow from place to place) some mass (energy), so the change from the simulated parameter (time) to natural (mass) taking into account its possible minimal value (quantization) is represented not only as the mad idea (regarding impression), but also opportune (regarding necessity) of the XX-th century end, which was expressed by the author of works [6, 7]. In these works he has returned the time concept to its frames from which the time concept left the bounds in XX-th century, being everything, except the equivalent for the velocity comparison of various processes passing. The SR, and GR as well as other theories have been created also outside these limits. And the authors began to substantialize the time in some theories and even have invented the particle of time — a chronon.

Lorentz transformations and already customary four-dimensional space-time dimensionality lose the right to life from the position of the new (or restored ancient) time definition, that will be shown below. New transformations and completely symmetric six-dimensional space-time (though discrete concept of dimensionality is not absolutely exact too, as the space-time is the continuous and deformable from a macrocosm and up to a quantum level) come instead of them.

3. The coordinates transformation of the light wave front

Let's consider two inertial reference frames $OXYZ$ and $O'X'Y'Z'$ with parallel axes of the same name for each other, and the second system goes regarding the first one with the velocity v along the axis OX thus, their beginnings O and O' coincide at some moment, which is a reference point. Let the light of particular frequency starts radiating at this moment from the point O'. The point O' will move to the distance vt, and the light wave front will achieve the points A, B, C, D, E, F (Fig.1) in the time t regarding the observer's clocks being in the point O.

It is obvious, that light is extend in all directions with equal velocity c according to the gauges of space and time of the observer, which is in a point O, and therefore the points A, B, C, D, E, F will be on the orb surface and the equality will be fulfilled (see Fig.1):

$$OA = OB = OC = OD = OE = OF = ct. \tag{3}$$

It is obvious also, that **each point along the light source line O', which corresponds to radiation of the next light wave, will be the center of every light wave following as to the orb radius diminution connected to this wave heckle.** These points will be in equal distance from each other as the radiant motion velocity is constant. Thus, the general pattern of light waves heckles from the observer's positions being in the point O in the time t will look like as it is shown in the Fig. 1.

Let's form the triangle OAO' so that the point A would be placed in the arbitrary place of the light wave front. We have equalities according to the problem conditions: $OA = ctOO' = x = vt$. Let's designate the side $O'A$ as s, and the corner $OO'A$ as α. Then we have the following as for the cosine theorem

$$c^2t^2 = v^2t^2 + s^2 - 2vts\cos\alpha, \tag{4}$$

where from we discover the unknown parameter

$$s^2 = c^2t^2 - v^2t^2 + 2vts\cos\alpha. \tag{5}$$

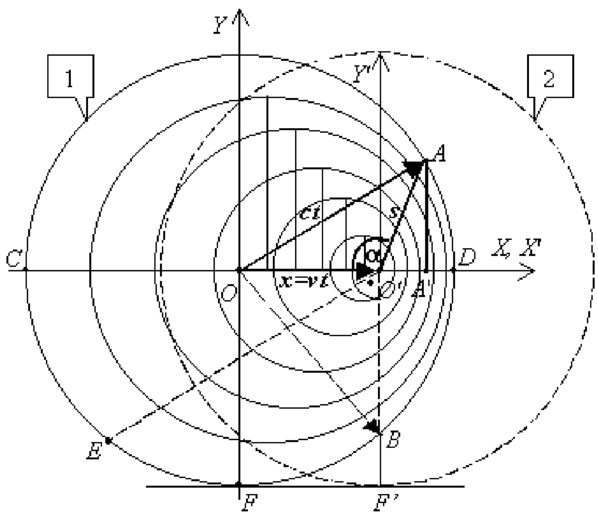

Figure 1: To the analysis of Lorentz transformations

It is easy to see, that this parameter is not the other in the right part without the last addend, as the square of interval between two events in the SR, which corresponds to light radiation in the point O' and to its reception in the point A:

$$s^2 = c^2t^2 - v^2t^2. \tag{6}$$

Therefore the physics laws (as it is considered) are covariant in all inertial reference frames, i.e. are featured by the similar equations, so the square of interval should be expressed similarly in the moving reference frame

$$s'^2 = c^2t'^2 - v'^2t'^2. \tag{7}$$

But as the motion system velocity v' is equal to zero in its own reference frame, the expression (10) becomes simpler to the view

$$s'^2 = c^2t'^2. \tag{8}$$

The known relation for the times follows from the intervals equality in two reference frames as it is considered in the SR.

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}. \tag{9}$$

Is it so really? And whether is it possible to simplify the expression (6) up to the view (8)?

Yes, the value s is invariant in any inertial reference frames. But it not the other, as only radius of the light wave front orb in a moving reference frame. If light will be radiated from the point O then the circles in the Fig. 1 will be concentric, and the orb appears absolutely symmetric as to the internal structure. But in our case the light is radiated by a moving radiant which is in the point O', and the figure has no symmetry (as it seems) concerning this point. But it seems only at the first sight.

Let's restrict the system motion time $O'X'Y'Z'$ and, accordingly, the light radiation time with one second according to the moving radiant gauges. And let there is the cesium - 133 light source on it. Then it will emit 9.192.631.770 light waves for one second which front will spread within 299.792.458 m regarding the same gauges. It is obvious, that the fixed observer in the point O will not see all 9.192.631.770 light waves, but only a part, which succeeded to reach it during the motion of the system mentioned above. And its frequency will be less according to the Doppler's effect (that is perfectly visible in the Fig. 1 according to the enlarged distance between the light waves heckles along the line CO').

And what the observer will see and calculate in the point O' according to his gauges of space and time? It appears that all distances

$$O'A = O'B = O'C = O'D = O'E = O'F = ct'. \quad (10)$$

will be absolutely equal for him as they will contain the equal number of light waves 9.192.631.770. As to the length and time units, which are ratified by the relevant conventions, the observer will consider that he is at the light orb center and he will be right in his own way. Thus, the space and time gauges are deformed simultaneously in a moving inertial reference frame and the light velocity has a constant value at the same time.

But the light wave front will be an orb for the observer in the point O as well, since the inertial reference frame centers coincided among themselves at the moment of this wave radiation, and it was indifferent whether it is radiated from a fixed or moving radiant. The coordinate transformations of the light wave front, given below, follow from these simple reasonings, they maintain the light wave front as invariant at the change from the fixed inertial reference frame to the moving inertial reference frame:

$$dx' = \frac{dx}{1-\frac{v}{c}};\ dy' = \frac{dy}{\sqrt{1-\frac{v^2}{c^2}}};\ dz' = \frac{dz}{\sqrt{1-\frac{v^2}{c^2}}};$$

$$dt'_x = \frac{dt_x}{1-\frac{v}{c}};\ dt'_y = \frac{dt_y}{\sqrt{1-\frac{v^2}{c^2}}};\ dt'_z = \frac{dt_z}{\sqrt{1-\frac{v^2}{c^2}}}. \quad (11)$$

It is necessary to note, that the obtained transformation group reflects only the relations between three spatial and three time projections of any front point of the light wave which are measured by two methods, but no more. But we shall call these 6 projections as 6-dimensional space-time further. Only the last three projections are identically equal to each other at measuring according to their own gauges and the use of traditional 4-dimensional space-time is possible.

Rather important conclusion that the space and time have the relative nature follows from the above-stated fact. For example, the same distance $OF = O'F'$ (Fig. 1), equal as to space and time gauges of the fixed observer, will be different regarding the space and time gauges of the moving observer. Light transits this distance for 1 s in the first case, and the light transits the distance for 1 s in the second case, equal only $O'B$. This follows from the 2-nd formula of the system (16) as well.

4. Comparison with Lorentz transformations

The expression (16) is the simplified alternative of the relativistic coordinate transformations, valid at their zero initial values (for the greater obviousness). It is easy to see, that any relations of unidirectional coordinates and times differentials

$$\frac{dx'}{dt'_x} = \frac{dy'}{dt'_y} = \frac{dz'}{dt'_z} = c \quad (12)$$

are the invariant value which is equal to the light velocity c, as it is observed in the real nature.

And now we shall analyze the expression (8) again. It is obvious, that it is true for a single case only, namely for the plane $O'Y'Z'$, which transits through the moving reference frame center O' and is perpendicular to the velocity vector of its motion concerning the fixed reference frame.

Really, if to consider the right triangle $OO'B$ (fig. 1) with the segment $O'B$ which lies in the plane, mentioned above, it is visible, that only the last addend in the expression (6) turns into zero in such a way that it turns into the expression (8) for it. Thus, it appears, that both the interval covariance and the use competency of Lorentz transformations are true only for orthogonal components of the conversed values (the traditional electrodynamics satisfies it).

And now we shall analyze the formulas of Lorentz transformations in more details:

$$dx' = \frac{dx - vt}{\sqrt{1-\frac{v^2}{c^2}}};\ dy' = dy;\ dz' = dz;$$

$$dt' = \frac{dt - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}. \quad (13)$$

Lorentz transformations are not simple as it seems at the first sight. First of all, it concerns to the relation between the time interval of any two events and the time unit value. It is obvious, that the increase in time unit (at any coordinate transformations), thus we reduce the time interval between two events. And on the contrary, reducing the time unit, we enlarge the time interval thus. What exactly is described by the transformations (18): the time interval change or the time unit change?

If we take $x = 0$ in the second relation of the expression (18), the expression will become

$$dt' = \frac{dt}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{14}$$

which coincides with the transformation formulas (16) for t_y and t_z, i.e. "works" only in the plane which is perpendicular to the motion velocity vector of the moving reference frame.

The expression for the time unit change at transition to the moving reference frame should be written down in such a way. But if the time interval is conversed, so the relation (21) will vary to the view

$$t' = t\sqrt{1-\frac{v^2}{c^2}}. \tag{15}$$

The formula as it is considered in a SR, describes the time course deceleration in the moving reference frame. However if the observer is in the moving reference frame, so all these reasonings have almost opposite character that is the complete nonsense of a SR.

Finally, if to pass to the corresponding relations of unities (differentials) of space and time the transformations should be written down as:

$$x' = x\left(1-\frac{v}{c}\right);\ y' = y\sqrt{1-\frac{v^2}{c^2}};\ z' = z\sqrt{1-\frac{v^2}{c^2}};$$
$$t'_x = t\ \left(1-\frac{v}{c}\right);\ t'_y = t\sqrt{1-\frac{v^2}{c^2}};\ t'_z = t\sqrt{1-\frac{v^2}{c^2}}. \tag{16}$$

It is known that electromagnetic waves in Maxwell's electrodynamics are cross, i.e. their vectors of electrical E and magnetic H strengths are in a perpendicular plane to the propagation direction. The application of Lorentz transformations to these components of an electromagnetic field gave the only exact result that became the triumph of Lorentz transformations. It induced the scientists to consider all the remaining combinations to be correct as well.

Meanwhile, a series of electromagnetic phenomena (longitudinal electromagnetic waves, longitudinal forces between current elements, non-observance of conservation laws in some problems of the traditional electrodynamics, etc.) have already put the universal regularity of Lorentz transformations and completeness of Maxwell's equations under doubt for a long time. These transformations discordance to the elementary definitions of the length and time units is the new proof for it.

Also the important deduction about the synchronous deformation existence of space and time at transition from one inertial reference frame to another, instead of the time deceleration as it is accepted in a SR, follows from the reasonings mentioned above. This deduction is proved by the fact that the transformations (16) and (28), mentioned above, not only maintain the light velocity as invariant, but also yield the exact results for light aberrations and Doppler's cross effect. At the same time Doppler's longitudinal effect for light should be expressed by the same formula, as well as Doppler's relevant effect for sound at the fixed radiant regarding air. It is the result of two transformation differences, concerning only longitudinal components of the conversed values.

5. Simple consequences of non-Lorenz' coordinate transformations

5.1. Light aberration

The exact expression for a corner light aberrations θ follows at once from formulas of space deformation in longitudinal and a transverse direction to the motion velocity (16). This angle tangent is equal to the deformation ratio of spatial gauge in a longitudinal direction to the deformed gauge in the cross direction (that coincides with the relativistic formula):

$$tg\ \theta = -\frac{\sqrt{1-\frac{v^2}{c^2}}}{\frac{v}{c}}. \tag{17}$$

5.2. The cross Doppler's effect

The effect is connected directly to the spatial gauges deformation in the cross direction and exhibited as the frequency diminution of the received signal ω in relation to the radiated source frequency ω_0 according to the formula (which coincides with the relativistic as well):

$$\omega = \omega_0\sqrt{1-\frac{v^2}{c^2}}. \tag{18}$$

5.3. The longitudinal Doppler's effect

This effect is connected to the spatial gauges deformation in a longitudinal direction and exhibited as diminution (at removing) or magnifications (at approaching) of the received signal ω frequency in relation to the radiated source frequency ω_0 according to the formula

$$\omega = \omega_0\left(1 \pm \frac{v}{c}\right). \tag{19}$$

The obtained formula coincides with the relativistic only in the first (linear) approach. Probably, there is a particular sense already in it, which will be exhibited at the further comparison of normal coordinate transformations with obviously false Lorentz transformations.

6. Conclusion

It would be desirable to give the Pauli's reasoning and show its erroneous in the summary. He writes in the book [9]: "The relativity principle and the constancy principle of the light velocity seem incompatible at the cursory examination. Let, for example, the observer A goes with the velocity v regarding to the light source L, and the observer B is fixed regarding to the light source L. Thus both observers see orbs as the wave front which centers are rested regarding to the observer, i.e. they see two various orbs. However, the inconsistency disappears if to suppose that the space points to which the light has reached simultaneously from the observer's A point of view, the light reaches not simultaneously from the observer's B point of view".

But we have shown, that one orb has two various centers and it does not contradict to the observed phenomena at all: to the light velocity constancy (if it is measured according to natural gauges of space and time) and the phenomena processing uniformity in different inertial reference systems.

Moreover it is necessary to add the fact that Maxwell's combined equations of electrodynamics is incomplete as to his own admission. Hence there are only the cross electromagnetic waves for the free space characterized by the fact that the vectors of electrical and magnetic intensity of these waves are in the plane, which is perpendicular to the Pojting vector (their distribution direction).

But the transformations (16) for this plane and Lorentz transformations like (21) or (27) coincide, i.e. Lorentz transformations for vectors of electrical and magnetic strengths give the exact result. Maxwell's equations invariance in relation to Lorentz transformations became the triumph of XX century beginning, but the tragedy simultaneously, which has hidden the incompleteness of these equations and the existence of longitudinal electromagnetic waves from million of people, which could not "be located" into Lorentz transformations.

Moreover, everything, that concerned longitudinal components (for example, the field form of a moving charge), appeared erroneous due to the fact that transformation equations of the actual process (16) and Lorentz transformations yield different results.

And now the attempt to receive or confirm the Lorentz transformations available in a new theory at any price is the key hindrance, which has already delayed the physics development for about 100 years.

References

[1] N.A. Zhuck. "About some results following from the gravitation law". Borisoglebsk, BVVAUL, 1986, 58 p. (in Russian).

[2] N.A. Zhuck. "Cosmology." Kharkiv, "The Universe Model" Ltd., 2000, 464 p. (in Russian).

[3] The physical encyclopedic dictionary. Moskow, "Soviet encyclopedia," 1984, p. 582 (in Russian).

[4] The physical values. Manual. Moskow, "Energoatomizdat", 1991, p. 9 (in Russian).

[5] L.A. Sena. "Unities of physical values and their dimensionalities." Moskow, "Nauka," 1988, pp. 48–50 (in Russian).

[6] I.M. Galitsky. "New in physics, mathematics, science." Gomel, FENID, 1992 (in Russian).

[7] I.M. Galitsky. "About new physics (Principles)." *Spacetime & Substance*, **2**, 2, 84–94 (2001).

[8] DISCUSSION: N.A. Zhuck — I.M. Galitsky. *Spacetime & Substance*, **2**, 2, 96 (2001).

[9] V. Pauli. "Theory of relativity." Moskow, "Nauka," 1991, p. 23–24 (in Russian).

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THE PHYSICOCHEMICAL TABLE OF A MATTER STRUCTURE

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January 27, 1999

The description of the physicochemical tables of Bolotov's izosters has been presented in English in the article for the first time. The tables are composed on the basis of positive investigations of inorganic compounds obtained while conducting the chemical reactions on energies from electron-volt units up to mega-electron-volt units. Considering the structures of isotopes and isobars on a general izosters' background, the authors have proposed the new theory of the matter structure distinct from the atom planetary structure. Introducing the world model as the combination of three-dimensional space and three-dimensional time, the authors present their own model of the atom elementary particle — electron-positron resonator being the loop of the matter true oscillating elements, which is capable to exist for a half-period in one space (as an electron), and for the second half-period — in the other space (as a positron). All nuclear particles and atoms are constructed of it. The structural diagram, proposed on the basis of Platon's bodies, makes the whole nature of nuclear particles and atoms to be universal. The atoms number in Nature is over ten thousand, and 105 D.I. Mendeleyev's table elements are only the special case of Bolotov's izoster table according to the izosters' physicochemical table.

1. Introduction

The background for the new table making of a matter structure is the general crisis in the field of nuclear particles physics. Science has a wide experience in chemical reactions investigation. The experiment technique became more perfect, and there are newest data of chemical elements and their compounds as the investigation result, which don't always correspond to D.I. Mendeleyev's elements table.

The results of the new elements table of elements called as the izosteres, are presented on the basis of continuous investigations of inorganic compounds obtained at chemical reactions conducting on energies of electron-volt units up to mega-electron-volt units. Considering the isotopes and isobars structures on a general izosters background, the authors propose to create the new theory of the matter structure, which differs from the atom planetary structure.

Allowing the deficiencies of D. I. Mendeleyev's element table, the authors give their own interpretation of the world hypothetical model, attracting the Universe composed of two spaces for this purpose:

1. The space, having the linear extent property in three coordinates.

2. The space, having the time extent property, in three coordinates as well.

Introducing the world model as two spaces, the authors present their own model of the atom elementary particle being the loop of the matter true oscillating elements (MTE), which can exist for half-period in one space, and the second half-period — in the other space. The authors called the particle, presented as a spherical surface squeezed into a dot and existing in the first part of half-period, as an electron, as well as they called the electron, squeezed into a dot, and existing in the second part of half-period as -electron or positron. Thus, the complete period of its own oscillating of electron and -electron is a pair of the electronic and -electronic resonator (EPR). All nuclear particles and atoms are created of it. The structural diagram, proposed on the basis of Platon's bodies, makes the whole nature of nuclear particles and atoms to be universal. Some preference is made for hydrogen atoms, which do not differ from nuclear particles by their structure and repeat nine structures similar to five Platon's bodies and four bodies, which are not inhered to Platon.

The atoms number in Nature is over ten thousand, and 105 D.I. Mendeleyev's table elements are a special case of the izosters table according to the izosters physicochemical table. Izosteres, as well as known atoms, are characterized by absorption frequencies. The authors guess, that, the absorption frequencies are connected to the electron mass, which differs from electron mass in vacuum and is often less of it. The izosters table elements, created on the basis of the magic numbers table, are located on the cylinder spiral line, the section of which is presented in a separate figure. The known parameters are given and new ones, calculated by the authors, are input per each element, in this table.

All of them will help the investigators and explorers in the field of chemistry, physics and nuclear physics

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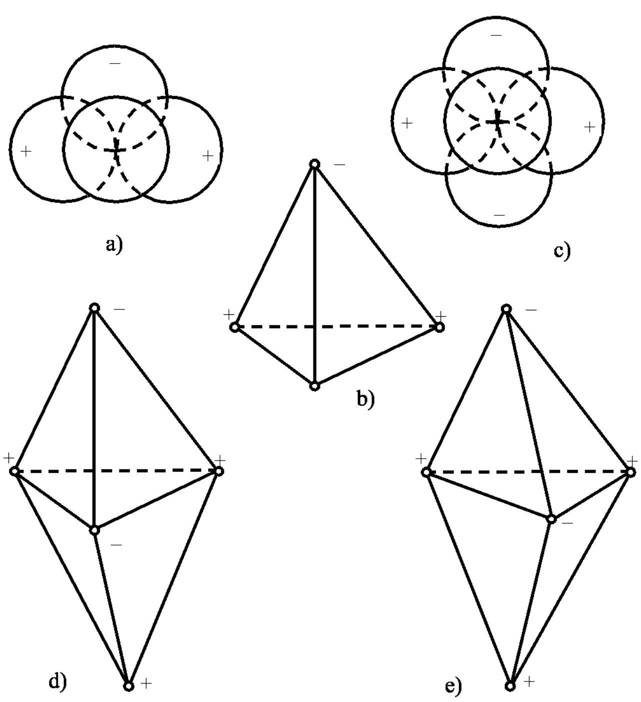

Figure 1: The lightest nuclear particles: a, b — neutral, composed of two EPR; c, d, e — charged, of which: d — the lightest meson; e — the lightest proton

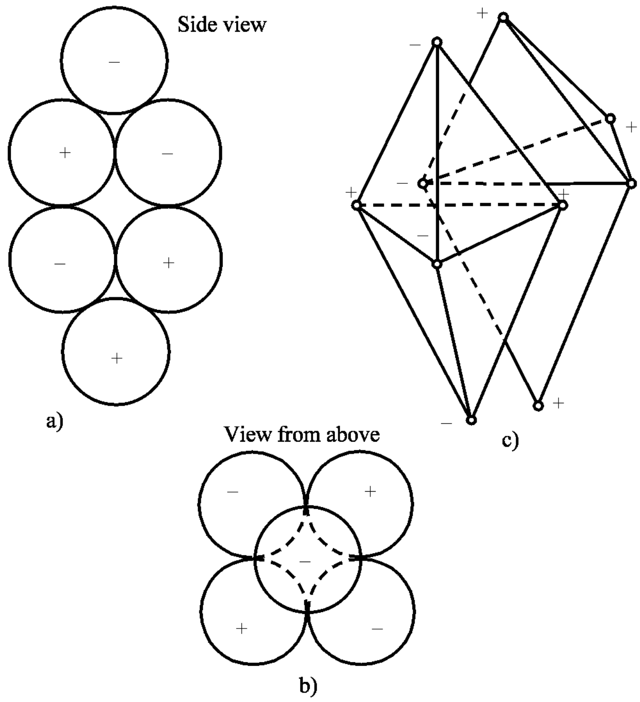

Figure 2: The lightest deuteron (Dt), formed by the lightest proton and meson combination

making the newest technologies for obtaining new materials and transforming old ones.

The book terminates with some reference data, necessary during the work with the izosters physicochemical table.

2. Nuclear particles

The elementary crystalline volumetric structure is the combination of two EPR (Fig. 1, a, b).

To imagine the structure formation of EPR more completely, we shall explain the charge originating in a composite system at the beginning. EPR is a neutral system from general point of view, as it consists always of an electron and π-electron with mutually opposite charges. An electron and π-electron compensate charge ability mutually, but, it appears, the space oscillatings will realize the charge ability per one unit either positive, or negative. So, in the lightest nuclear particle (Fig. 1, d) two EPR form a neutral nuclear particle, and the nuclear particle becomes already charged in the structure (Fig. 1, c), since there's one electron more in it. How can it be imagined, that if only there was EPR available per one charge unit more?

Really, such phenomenon arises due to the fact that electrons and π-electrons arise one-by-one. Therefore two π-electrons or vice versa can correspond to one electron at once, two electrons can correspond to one π-electron, as it is depicted in the Fig. 1, c. We can observe the adjacent coupling of two opposite charged particles (electron-positron), as well as two particles with the same charges in such structure. According to the schema such combination favors to one more charged particle joining (Fig. 1, c), either negative (Fig. 1, e) or positive (Fig. 1, d). The formed structure has a negative charge in the first case (since there are more electrons in number, than positrons), and it will have the positive charge in the second case. Apparently, we deal with the lightest meson in the first case (with the same mass — 0.00275 a.m.u.), and in the second case — with the most light proton (with the same mass). The meson in relation to a proton is a nuclear ion capable to form a covalent linkage. Therefore deuteron (Dt) is the easiest nuclear molecule (Fig. 2).

In general view electrons and the positrons are coupled in the form of crystals with reflecting symmetry and reflecting-antipodal symmetry. Let's call such symmetry as hyral, as not having the inverse center and plain [2].

If to pay attention to a tetrahedral structure of a nuclear particle crystal, so it can be noticed, that it has more complicated option. In that specific case tetrahedron (Fig. 1, a) can consist of ten charged particles (Fig. 3, a), and for a case of a Fig. 4, the number of charged particles will be 14. The even number of charged particles indicates that the data of crystalline structures are neutral.

More complicated structure of a tetrahedron, as it can be noticed easily, will consist of 20 charged parti-

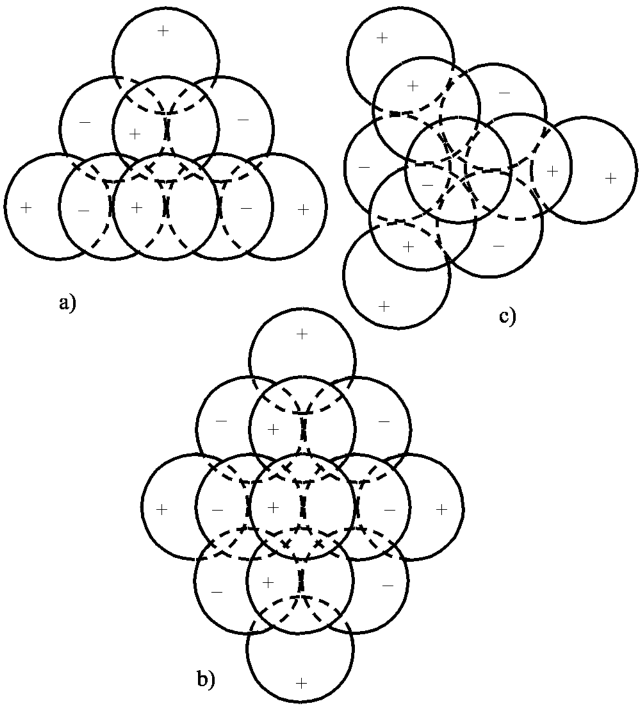

Figure 3: The complicated tetrahedral nuclear particles (tetrons)

cles, and dual tetrahedron consists of 30 accordingly. The consequent particle of tetrahedral habitues, as it can be esteemed easily, consists of 35 charged particles. The number 35, as we notice, is odd. Hence, such particle will have a charge either positive, or negative. It can be either paramagnetic, or diamagnetic in a magnetic ratio. Everything depends on that what there is more: electrons or positrons.

The consequent three more massive nuclear particles of tetrahedral habitues are also neutral, since the electrons and positrons number equaling is observed in them. Then the charged particle, composed of 165 elements, follows again. The whole succession of these particles numbers (let's call them as magic numbers), is written in the first line of the table 1 [1]. As to the nuclear particle (Fig. 2, c, d, e), so its analogy is recorded in the second line of same table. Here we also notice the magic numbers of nuclear particles, composed of odd number of charged elements, which are referred either to mesons or to protons.

The mesons are the basic anticores, and protons are customary cores of chemical elements. The magic number of charged elements for crystals like (Fig. 2, c) is determined according to the formula:

$$K_{n+1} = M_n + (n+1)^2 , \tag{1}$$

here K_{n+1} is the consequent magic number of charged elements; M_n is the previous value of a magic number; $(n+1)$ is the consequent number of a magic number.[1]

For example, we know the magic number of charged elements of the ninth nuclear particle, for which $M = 285$. Then $K_{9+1} = 285 + (9+1)^2 = 385$.

We shall call the nuclear particles of tetrahedral habitues as tetrons further, and the nuclear particles (Fig. 2, c) — as hexones.

The next nuclear particle as for complicity is formed as a cube or rhomb (Fig. 5). It is called as cubon or rhombon.

A cube, as it is accepted in crystallography, has a four-fold symmetry. However, if to look at the cube along the axis A-A, it can be detected, that the cube has also hyral (reflectory-antipodal) symmetry, since its three upper edges have no inverse to opposite edges. Even more obviously the hyral symmetry is expressed in a rhombohedron (Fig. 4, c, d, f).

The magic number of charged elements in the cube and rhombohedron (i.e. cubon and rhombon) is determined according to the formula:

$$M_n = n^3 \tag{2}$$

The magic numbers of charged elements for cubons and rhombons are given in the third line of the Table 1.

The charged and neutral nuclear particles in cubons and hexones repeat more often, than in tetrons. Therefore cubical genetics is spread more among nuclear particles. It is possible, that the atomic-molecular crystallography is obliged cubical habitues of nuclear particles especially.

Octahedral habitues is referred to the following more complicated shape of a nuclear particle (Fig. 5).

The nuclear particles of such shape are called as octons by us, they, as well as cubons, have the hyral symmetry (for example, along the axis A-A). Not incidentally, it appears, carbon, amino acids, sugar have the hyral symmetry, since carbon joins four different ligands in all four valences. Phosphorus and nitrogen have the same properties. Phosphorus crystals are octahedral. It can be considered, that the cores of these atoms bear genetics of octahedral nuclear particles (octons). If such a presupposition is correct, the sources of biological life begin from nuclear particles with hyral symmetry.

Octons differ by the number of charged particles. The simplest octon is the six-charge structure (Fig. 5). The next magic number for octons is the number 19. Naturally, such an octon has charging. We have called this special particle as a Demon. All consequent magic numbers for nuclear particles octons are given in the fourth line of the Table 1.

[1] The magic numbers dimensionality in space should conform to the cross section area, i.e. m^2. But though the magic numbers are determined on the basis of two three-dimensional spaces available (extent and time), so dimensionality will be determined by the velocity quadrate, m^2/sec^2.

Table 1: Magic numbers

Denomination	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Tetron	1	4	10	20	35	56	84	120	165	220	286	364	455	560
Hexon	1	5	14	30	55	91	140	204	285	385	506	650	819	1015
Cubon, rhombon	1	8	27	64	125	216	343	512	729	1000	1331	1728	2197	2744
Octon (bipyramin-4)	1	6	19	44	85	146	231	344	489	670	891	1156	1469	1834
Dodecon-1	1	7	13	45	167	439	921	1673	2755	4227	6149	8581	11583	15215
Icosom	1	7	13	55	147	309	561	923	1415	2057	2869	3871	5083	6525
Roy	1	8	15	65	175	369	671	1105	1695	2465	3439	4641	6095	7825
Hyron	1	9	35	91	189	341	559	855	1241	1729	2331	3059	3925	4941
Biocton	1	11	45	119	249	451	741	1175	1689	2339	3141	4111	5265	6619
Pyramin-4	1	5	14	30	55	91	140	204	285	385	506	650	819	1015
Pyramin-5	1	6	21	51	101	176	2SI	421	601	826	1101	1431	1821	2276
Pyramin-6	1	8	27	64	125	216	343	512	729	1000	1331	1728	2197	2744
Bipyramin-5	1	7	27	72	152	277	457	702	1022	1427	1927	1532	3252	4097
Bipyramin-6	1	9	35	91	189	341	559	855	1241	1729	2331	3059	3925	4941
Granaton-1	1	7	34	116	302	640	1178	1964	3046	4472	6290	8548	11294	14576
Granaton-2	1	6	38	160	432	914	1666	2748	4220	6136	8574	11576	15208	19530
Dodecon-2	1	7	29	66	118	185	267	364	476	603	745	902	1074	1261

Denomination	15	16	17	18	19	20	21	22	23	24	25
Tetron	680	816	969	1140	1330	1540	1771	2024	2300		
Hexon	1240	1496	1785	2109	2470	2870	3311	379S	4324		
Cubon, rhombon	3375	4096	4913	5832	6859	8000	9261	10648	12167	13824	15625
Octon (bipyramin-4)	2255	2736	3281	3894	4679	5540	6481	7506	8619		
Dodecon-1	19537	24609	30491	37243	44925	53597	63419	74451	86753		
Icosom	8217	10179	12431	14993	17885	21127	24739	28741	33153	37995	43287
Roy	9855	12209	14911	17985	21455	23345	29679	34481	39775		
Hyron	6129	7471	9009	10745	12691	14859	17261	19909	22815	25991	29449
Biocton	8189	9991	12041	14355	16949	19839	23091	26621	30495		
Pyramin-4	1240	1496	1785	2109	2470	2870	3311	3795	4324		
Pyramin-5	2801	3401	4081	4846	5701	6651	7701	8856	10121		
Pyramin-6	3375	4096	4913	5832	6859	8000	9261	10648	12)67	13S24	15625
Bipyramin-5	5077	6202	7482	8927	10547	12352	14352	16557	18977		
Bipyramin-6	6129	7471	9009	10745	12691	14861	17261	19909	22S!5	25991	29449
Granaton-1	18442	22940	2S118	34024	40706	48212	56590	65888	76154	87436	99772
Granaton-2	24602	30484	37236	44918	53590	63312	74144	86146	99378		
Dodecon-2	1463	1680	1912	2159	2421	2698	2990	3297	3619	3956	

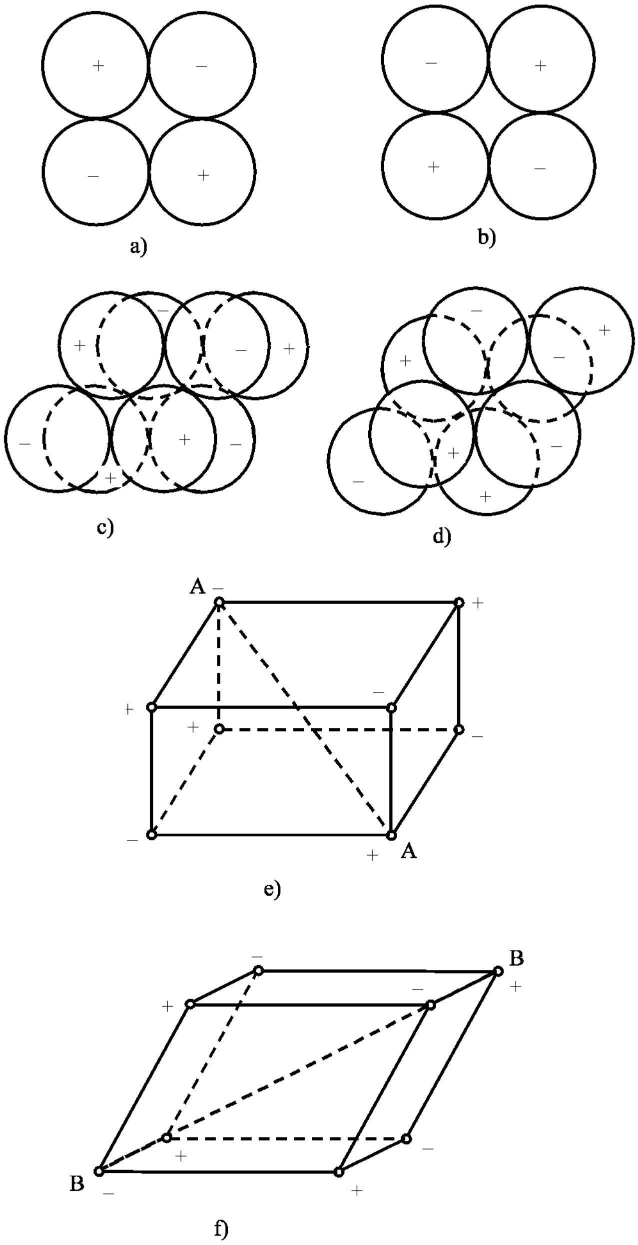

Figure 4: Cubical a, b, e rhombic c, d, f nuclear particles (cubons, rhombons)

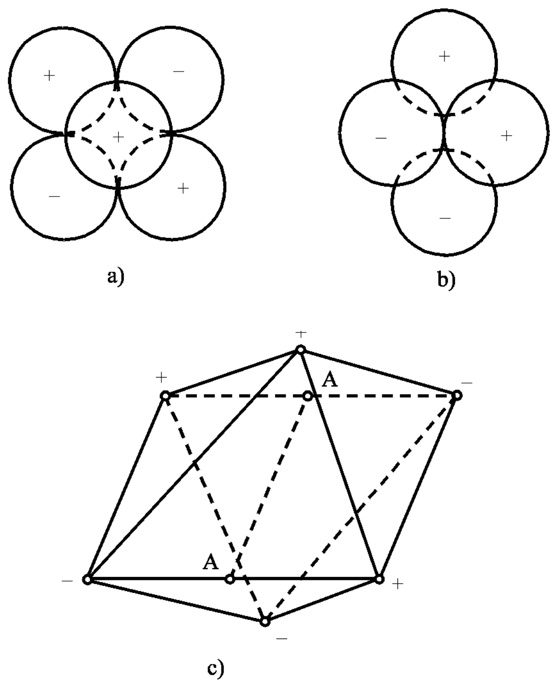

Figure 5: Octahedral nuclear particles (octons)

Other variety of nuclear particles has dodecahedral habitues (Fig. 6) called us as dodecon. Elementary dodecon consists of seven charged elements, and the next magic number in a series of dodecons is the number 13.

All consequent particles also consist of odd number of charged elements because one of charged elements is clipped at the center of dodecon nucleus. Basically dodecon can be hollow. In this case dodecons will have a neutral common charge, that it can't be told about their edges, which will have always nonzero charging.

We have called dodecon, composed of 13 charged elements as cherton (Fig. 7, c, d). All consequent magic numbers of nuclear particles such as dodecon are presented in the fifth line of the Table 1. The magic numbers of other dodecon packaging are calculated according to the formula:

$$n = \frac{1}{2} N \left(15N - 1\right). \qquad (3)$$

They, in particular, are given in the 17th line.

Dodecons have a hyral symmetry, and therefore are capable to create a biological life variety distinct of biological life on carbon, phosphorus, nitrogen, since the octahedral hyrality differs essentially from dodecahedral hyrality. The substances with dodecahedral hyrality most likely will be similar to spiders, squids, crabs, marine stars having the number of limbs multiple to five (for example, they have three pairs of legs, two wings and two gripping limbs as insects). Dodecahedral crystals are formed among organic substances too.

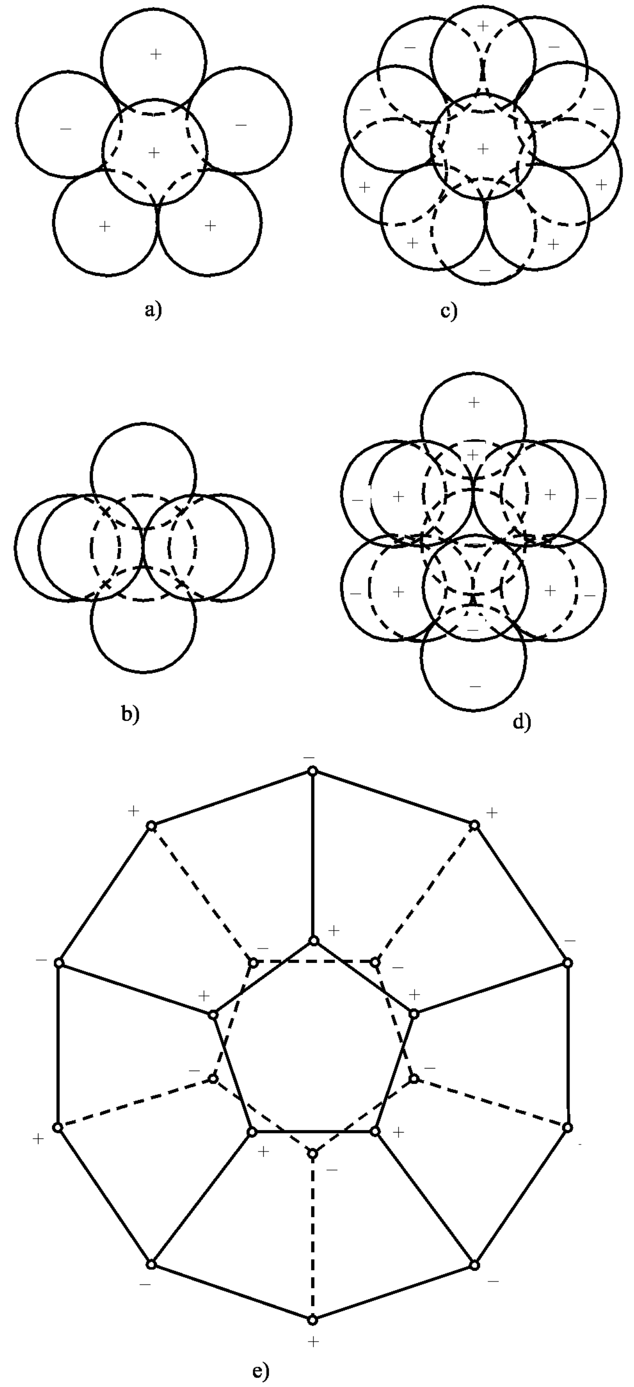

Figure 6: Dodecahedral structure of nuclear particles (dodecons)

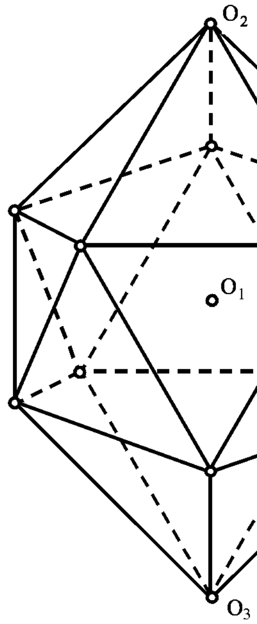

Figure 7: Icosahedral structure of nuclear particles (icoson)

For example, the combination $C_{20}H_{20}$ crystallizes as a dodecahedron. It is curious to note, that the spherical surface of a dodecahedron is more, than the tetrahedron surface in 12 times and the cube surface is more in 3.44 times.

Hexahedron and tetrahedron are the elements of more composite nuclear particles. So, for example, the regular icosahedron basically can be assembled of 10 hexahedron particles, though it, as well as dodecahedron, develops from a genetic nucleus called as icoson by us (Fig. 7).

Icoson takes its geometrical beginning from cherton. Therefore the particle composed of 55 charged elements (see the Table 1, the sixth line) can be considered as the first nuclear particle. Icosons, as well as dodecons, consist only of odd number of charged elements. Therefore they always have a charge and always have a spin as other protons and mesons, which consist not only of quarks spin, as it is considered in contemporary physics, but it consists of electrons and positrons spins [3].

Nuclear particles can be characterized by four forms except of Platon's five considered bodies.

For completeness and depth of substances property analysis, describing magnetism, we shall consider their design features briefly. So, major of them, in our opinion, is rhombododecahedron (Fig. 8), called as rhon by us.

Such structures of nuclear particles appear as a result of strong squeezing electric and nuclear forces, and also at disintegration b^0 — mesons containing b — quark, on a proton, negative proton and pions, that is explained by direct transmutation of heavy b — quark into common light quarks. Really, the quarks of a quan-

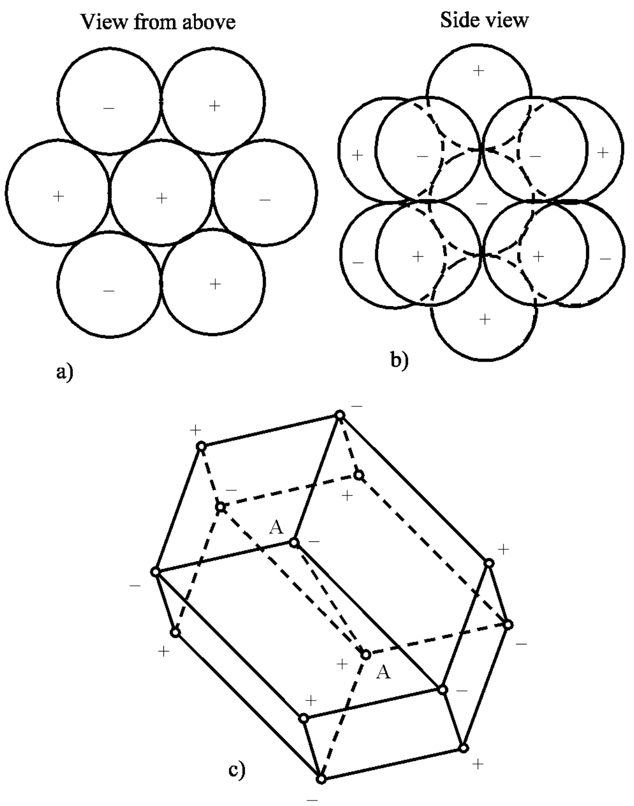

Figure 8: Rhombododecahedron structure of a nuclear particle (rhon)

tum chromodynamics are not identical to quarks of the theory of electrical weak interactions. It is known for a long time, that light d — quark of electrical weak interaction contains the impurity S — quark of the second generation. The detected disintegrations demonstrate, that it is blended not only with S — quark, but also with b — quark of the third generation. Thus the quarks interaction constant can be complex without the energy positiveness violation, that results in the combined parity violation.

On the other hand, there is no answer to a question about a nature of particles masses in physics (so-called hyggsovsky mechanism of masses occurrence W and Z — bozons), neither about generations nature, nor about an interaction constant nature and blending phenomenon. The problem of a neutrino mass is not resolved. Therefore the proposed model and the theory of nuclear particles have as a direct ratio both to color gluons states as to an atomic core in general. The magic numbers of the Table 1 are initial constants of all nuclear particles. Let's go on their brief viewing in that aspect, as well as Platon's five previous bodies. The magic icoson numbers are calculated according to the formula:

$$n = \frac{1}{3}\Big[10\,(n-10)^3 - 15\,(n-1)^2 + +11\,(n-1) - 3\Big]. \qquad (4)$$

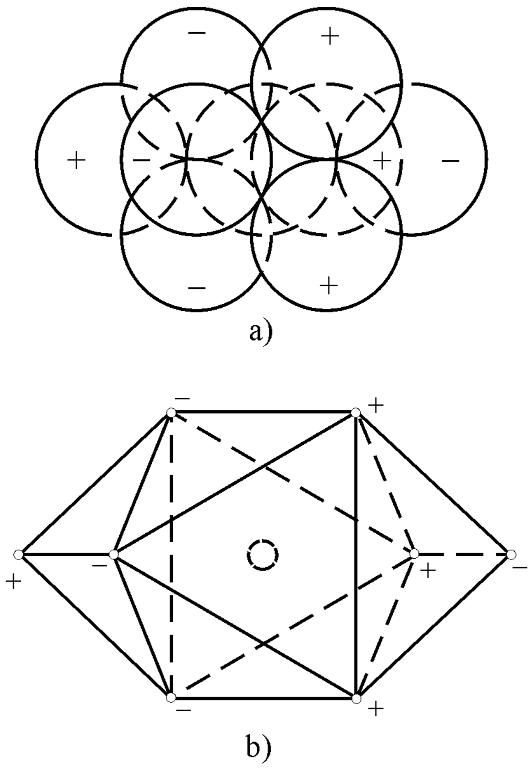

Figure 9: A nuclear particle — hyron

And the calculation of magic numbers for rhons is complicated a bit, since not two but three charged elements ($+-+$ or $-+-$) are arranged between two groups of six charged elements as it is specified in the Fig. 8, b. In this case the genetic germ is eight-element crystal, as a cube has (two charged elements are fitted by six others). This element is alone neutral apparently in the whole series of rhones. As rhone of eight elements is genetic for cubon and rhombon, we shall consider the rhone, composed of 15 elements as genetic one too (see Table 1, the seventh line). Rhones have a hyral symmetry (see axis — A), and therefore they are the carriers of biological life.

A little simpler nuclear particle with a hyral symmetry is depicted in the Fig. 9. It consists of two groups of charged particles by 4 elements of squeezed electric and nuclear forces.

It can be guessed, that the ninth charged particle of small size (depicted with a broken line in the Fig. 9, a) is inside. By virtue of these circumstances all nuclear particles of similar habitues, called as hyrons by us, will always have charging. The magic numbers for charged elements of hyrons are given in the eighth line of the Table 1.

More complicated nuclear particle with hyral symmetry is presented in the Fig. 10. It has its genetic beginning from two five-element pyramids moved regarding each other in 45°. The eleventh charged particle is clipped between backgrounds. It is depicted by a broken line of a bit smaller size in the Fig. 10.

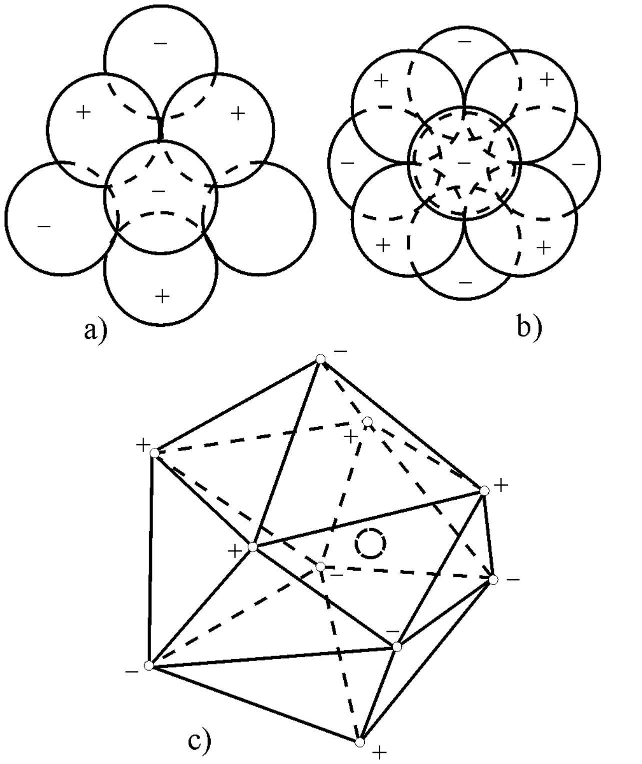

Figure 10: A nuclear particle — biocton

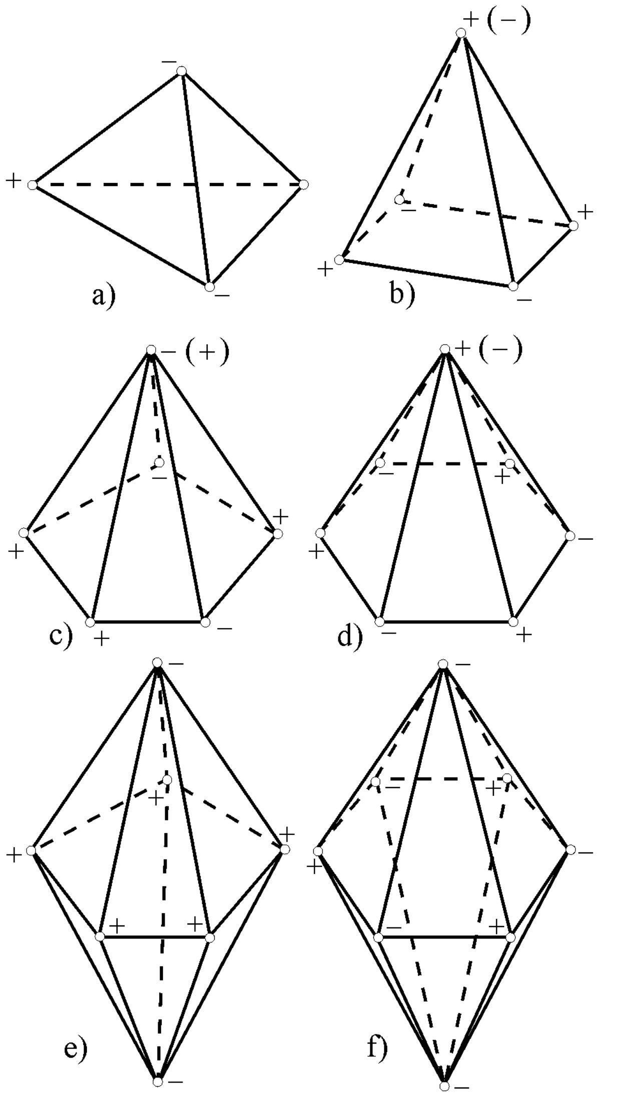

Figure 11: Nuclear particles are pyramins (a, b, c, d) and bipyramins (e, f)

The genetics of all nuclear particles of the considered habitues will always have charging and have a spin due to it. Such particles are called bioctons, since the number of their edges is even twice more than the number of octon edges. The calculation of magic numbers of biocton charged elements is given in the Table 1, the ninth line.

Among pyramidal nuclear particles, except tetrons, there are also other options. Some of them are depicted in the Fig. 11. We have called all pyramidal nuclear particles on the background of vertexes number as pyramins (Fig. 11: b — pyramin-4: c — pyramin-5; d — pyramin-6).

The magic numbers of charged elements at pyramins are given in the Table 1 accordingly in 10th, 11th, 12th lines. The magic numbers for bipyramins are given accordingly in 13th and 14th lines.

The nuclear particles with habitues tetragontrioctaedr, called as granatons by us (Fig. 12), are the particles, the last in complicity and relative in simplicity. The magic numbers of charged elements values for granatons are given in the Table 1 accordingly for granaton-1 (Fig. 12, d) in 15th line, and for granaton-2 (Fig. 12, b) in 16th line.

Granaton (Fig. 14) is a prolongation in granaton progressing (Fig. 12, b). It is assembled on the basis of pyramins (Fig. 12, d). If there are 8 pyramins in the granaton (Fig. 13, b), there are already 20 in the granaton (Fig. 13). The vertexes of these pyramins are dodecahedron. Therefore the beginning in granaton forming (Fig. 13) is a nuclear particle dodecon, cherton is its germ accordingly.

If to pay attention to a series of hexones and a series of pyramin-4, so it is possible to detect, that they consist of the same number of charged elements. As it is known, the most probable shape of atoms crystal is cubical. An example of it is carbon (diamond), iron, gold, iridium, lead, silver etc.

The examples of tetragonal singonies are indium, tin, and hexagonal — graphite, carbon, radium, ruthenium, zinc. The basic laws of chemical elements periodicity can be determined depending on singonies of atom crystalline structure.

A lot of rather important information for nuclear physics and physics in general can be detected analyzing the Table 1. Really, the magic number 14 for octons is the conventional neutron, because it consists of 1834 charged particles. The neutrality of it is clear, because

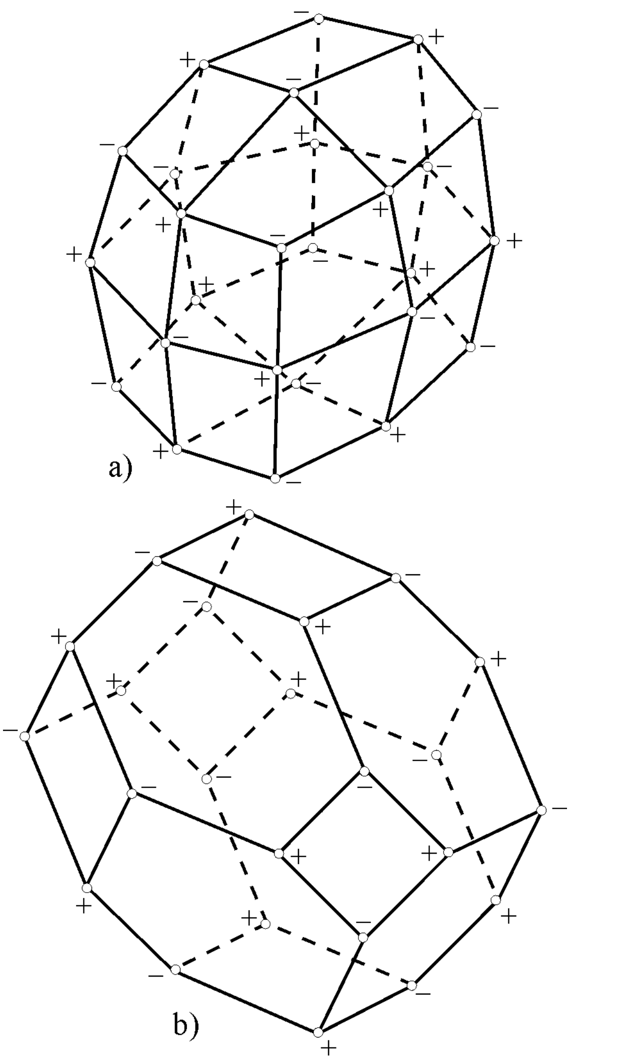

Figure 12: Nuclear particles granatons: a — granaton-1; b — granaton-2.

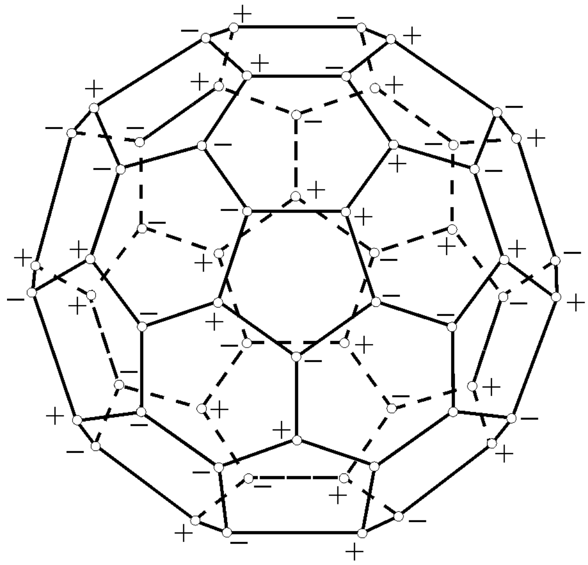

Figure 13: Granaton with cherton's germ

it consists of 917 electrons and 917 positrons, and, on the other hand, it is more than an electron in 1834 times as to its mass. The same number is gained, if the neutron energy (it is equal 939 MeV) can be divided into electron energy ($W_e = 0.512\ MeV$).

Then

$$\frac{W_{n^0}}{W_e} = \frac{939}{0,512} = 1834. \tag{5}$$

The same is gained if their masses can be compared:

$$\frac{m_{n^0}}{m_e} = \frac{1,0086}{0,00055} = 1834. \tag{6}$$

The odd magic numbers are specific for mesons and protons. So, in particular, the magic numbers 1469 and 2255 are specific for protons. It is 13th and 15th number of octon series. Perhaps, the average number will be:

$$N_{cp} = \frac{(1469 + 2255)}{2} = 1862 = 2 \cdot 931 = 2C^2. \tag{7}$$

This number also determines a multiplicity of proton mass in relation to an electron. On the other hand the number 931 is nothing else than the quadrate of light speed. Hence, the link of electron energy with the energy of a nuclear particle W_{cell} is determined as:

$$W_e = \frac{W_{cell}}{N_{average}} = \frac{C^2 m_{cell}}{N_{cell}} = \\ = \frac{931 m_{cell}}{2 \cdot 931} = \frac{C_1^2 m_{cell}}{2}. \tag{8}$$

Here m_{cell} is the mass of a nuclear particle in a.m.u.; W_e is the electrons energy of this nuclear particle in MeV;[2] C_1^2 is the velocity equal to a unit. In further this parameter reduces.

Hence, the precise mass of this nuclear particle will be equal:

$$m_{average} = 2 \cdot 0.512 - 1.024\ a.m.u. \tag{9}$$

Let's suspect that we shall determine the protons mass as $m_p = 1.00752\ a.m.u.$ experimentally.

Then the electrons (positrons) energy will be

$$W_{e(n)} = \frac{m_p}{2} = \frac{1.00752}{2} = 0.50376\ MeV. \tag{10}$$

Accordingly, the electrons mass in such a proton will be:

$$m_e = \frac{W_e}{C^2} = \frac{0.50376}{931} = 0.000541\ a.m.u. \tag{11}$$

As we note, the electrons mass in a proton is less than the electrons mass in a vacuum.

[2]Because light velocities in the expression (10) reduced, so the energy W_e is equal numerically to the mass m and vice versa, the mass m is equal numerically to the electron energy W_e. The dimensionalities are missed here.

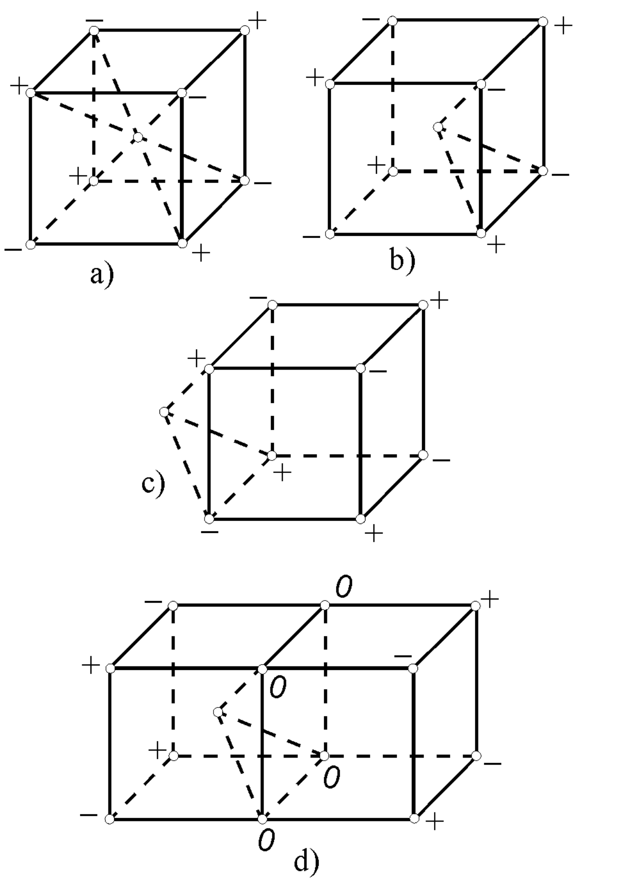

Figure 14: The schema of pseudo-nuclear coupling of boron and nitrogen: a — carbon atom; b — boron atom; c — nitrogen atom; d — boron and nitrogen coupling (boronozon)

If to take the magic number No 22-3795 (for pyramin-4) for a deuterium and the deuterium mass to take equal $m_d = 2.014\ a.m.u.$, so the electrons (positrons) mass of deuterium will be equal:

$$m_e = \frac{m_d}{n} = \frac{2.014}{3795} = 0.0005307\ a.m.u. \qquad (12)$$

Hexone No 22 has the same magic number, but electrons mass can differ a little in it. The mass of the deuterium electrons for octons No 18-3894 at a deuterium mass $m_d = 2.01474\ a.m.u.$ will be

$$m_e = \frac{m_d}{3894} = \frac{2,01474}{3894} = 0,0005174\ a.m.u. \qquad (13)$$

Electrons and positrons are concentrated during the nuclear particles growth and we observe photons radiating. Here we deal with a photoelectric reversible process.

If the system absorbs electrons, so it should radiate photons at the expense of their self-concentrating in nuclear particles. And, on the contrary, if nuclear particles emit electrons, so we observe photon absorption.

The energies at the electron-volt (eV) level participate in electron-photon interactions. Energy of kilo-electronvolt (keV) is required for protons or neutrons breaking off

3. The boron and nitrogen reaction

Let's consider an example of boronozon transmutation into carbon. Let carbohydrate atom is formed by coupling of six deuterium atoms (Fig. 14, a). Then the boron atom will differ from carbon atom only by the lack of one heterium atom (Fig. 14, b), and nitrogen atom will differ by deuterium available (Fig. 14, c).

The chemical boron and nitrogen coupling means entry by the top of nitrogen deuterium atom into the cavity of missing boron deuterium atom. As a result of such coupling the link of two carbon atoms is formed [Fig. 14, d). Such coupling is so strong, that it comes nearer to diamond as for its properties than to carbon. The nuclear boron and nitrogen coupling can also be estimated as follows. Apparently, this reaction can go in two directions, namely:

$$\overset{\nearrow H \searrow}{B^5 + N^7} = Be^4 + O^8 + W_1;$$

$$\overset{\swarrow H \nwarrow}{B^5 + N^7} = C^6 + C^6 + W_2.$$

In the first case hydrogen atom is thrown from boron atom to nitrogen atom, as a result of which two new atoms are formed. Bohr turns into beryllium, and nitrogen turns into oxygen. In the second case both atoms — boron as well as nitrogen turns into carbon.

The energies W_1 and W_2 are calculated on the basis of electron masses deformation according to the formulas (28) or (19). The atom energy can be determined according to the formula (19), having taken the absorption frequency for a boron $3179.35A°$, we shall receive the energy for $W_B = 3.181\ MeV$ or for other close frequencies $W_B = 3.159\ MeV$ approximating this frequency up to 3180.

According to the table 4 [1] it is possible already, to write out the energies for beryllium $Be = 2.564\ MeV$, carbon $C = 3.029\ MeV$, oxygen $O = 4.55\ MeV$, and nitrogen $N = 4.167\ MeV$ without using the formula (19).

The energies W_1 and W_2 will be

$$W_1 = W_B + W_N - W_{Be} - W_O =$$
$$= 3.181 + 4.167 - 2.504 - 4.55 - 0.294\ MeV;$$
$$W_2 = W_B + W_N - W_C - W_C =$$
$$= 3.181 + 4.167 - 3.029 - 3.020 = 1.29\ MeV.$$

The second reaction goes with major energy release. The similar pseudo-nuclear couplings occur in other atoms assembled of enumerated nuclear particles (see the Table 1).

4. Link of spectral lines

As the nuclear particles are assembled of electron-positron resonators, so the performance of all nuclear particles can be the frequency spectrum of radiation and absorption. So, we establish the dependencies of radiation and absorption frequencies in electron-positron resonators, with which this or other substance or nuclear particle can be estimated. One of such dependencies looks like:

$$\lambda_n = \frac{\lambda_e\,(m_{e^2} + m_{n^2})}{(m_{e^2} - m_{n^2})}. \tag{14}$$

Here m_n is the electron mass in a.m.u.; m_n is the positron mass in a.m.u.; λ_n, λ_e is the length of positron and electron waves; $\lambda_n = \frac{C}{(\nu_e - \nu_n)}$ or $\lambda_n = \frac{C}{(\nu_n - \nu_e)}$, $\lambda_e = \frac{C}{(\nu_e + \nu_n)}$; C is the light speed.

The wave length λ_n *and* λ_e and A° is determined in A°. The mass ratio m_e and m_n depends as:

$$\frac{m_e}{m_n} = \sqrt{\frac{\nu_n}{\nu_e}}. \tag{15}$$

Here ν_n is the proper frequency of positron oscillating; ν_e is the proper frequency of electron oscillating.

The mass of a nuclear particle is determined as:

$$m_{cell} = \lambda_p 4.26 \cdot 10^{-4}.$$

m_{cell} is the mass of a nuclear particle in a.m.u.; λ is the wave length of absorption frequency in A°; $4.26 \cdot 10^{-4}$ is trial-and-error coefficient calculated by the authors.

For definition of electron mass of this or that nuclear particle or atom as a whole it is possible to use the formula:

$$m_e = 2284.7\lambda_p. \tag{16}$$

For example, carbon has two absorption frequencies $\lambda = 2478.57A^\circ$ and $\lambda = 2524.12A^\circ$ then electron mass will be

$$m_{e1} = 2284.7 \cdot 2478.57 \cdot 10^{-10} = 0.0005663\ a.m.u.$$

$$m_{e1} = 2284.7 \cdot 2524.12 \cdot 10^{-10} = 0.0005767\ a.m.u.$$

Apparently, the first mass m_{e1} corresponds to graphite, the second m_{e2} corresponds to carbon (soot).

Perhaps, the energy measure EPR can be determined according to the expression

$$W = C^2 m_{en} = C^2 \beta \lambda_p, \tag{17}$$

where W is the energy in MeV; C is the light speed ($C^2 = 931$); m_{en} is the equivalent mass EPR in a.m.u.; β is the coefficient ($\beta = 228.47$); λ_p is the wave length of absorption frequency, m.

The energy of any atom is determined by electron and proton number. As there is always one electron and one positron in EPR, so the expression (28) for atom can be written down as

$$W_a = 2nJ\lambda_p \cdot 10^{-4}, \tag{18}$$

where W_a is the atom energy in MeV; n is the atom number in the izosters table; J is Illarion's coefficient ($J = 1.0635278$); λ_{en} is the absorption frequency in Å.

The Illarion's coefficient is taken equal to a unit in the Table 4. The computed values of atom energy are given in this table except of probable nucleons numbers. The energy calculation, released in reaction or absorbed between a pair of registering izosters could be made according to these data.

5. Potentials of ionization

The potentials of izosters ionization differ essentially from each other. So, for example, carbon (graphite) has the ionization potential 138 eV. And carbon (soot) has the ionization potential about 39 eV, moreover it is negative [4]. Phosphorus (black) has also the ionization potential close to carbon (soot) and is equal about 32 eV (see the chart of the Fig. 16). Chromes, molybdenum, niobium, platinum have the ionization potentials, close to carbon (graphite). The specific dependence of the ionization potentials (curve 1) for these elements is shown. We specified phosphorus, arsenic, antimony, thulium, francium, nilsboron, sadiy (Sa^{123}_{325} — Andrey Dmitrievich Sakharov) on the same curve. These elements with such ionization potentials are still unknown, but they undoubtedly exist and in due course will be found.

Boron has the ionization potential about 70 eV, silicon - 82 eV, vanadium - 92 eV, germanium - 100 eV, niobium - 102 eV, tin - 102 eV, prazeodim - 101 eV, erbium - 100 eV, iridium - 98 eV, radon - 91 eV.

The curve of ionization potentials for these elements, their isobars and other still not found (for example, such as Ge) is indicated with the digit 2.

Beryllium has the ionization potential 40 eV, aluminum - 50 eV, titanium - 57 eV, gallium - 62 eV, zirconium (one of its izosters) - 68 eV, indium - 69 eV, cerium - 69 eV, holmium - 68 eV, osmium - 66 eV, astatine - 61 eV, plutonium - 56 eV, lawrencium - 47 eV, (see the curve 3).

Lithium has the ionization potential 28 eV (lithium - 6), magnesium - 30 eV, scandium - 35 eV, zinc - 38 eV, yttrium - 40 eV, cadmium - 41 eV, lanthanum - 41 eV, dysprosium - 41 eV, rhenium - 39 eV, (see the curve 4).

Helium is ionized at 19 eV, sodium - 20 eV, calcium - 21.5 eV, copper - 22 eV, strontium - 22 eV, silver - 22 eV, barium - 22 eV, terbium - 22 eV, tungsten

- 21 eV, bismuth - 20 eV, uranium - 10 eV, (see the curve 5).

Hydrogen is ionized at 10 eV, neon - 10.8 eV, potassium - 11 eV, nickel - 11.2 eV, rubidium - 11.5 eV, palladium - 12 eV, cesium - 12 eV, gadolinium - 12 eV, tantalum - 12 eV, lead - 12 eV (see the curve 6).

Some lead isotopes have ionization potential about a hundred electron-volts. It just demonstrates, that such lead should be referred not to lead isotopes, but to isobars of iridium or radon (see the curve 2, Pb). In a series of fluorine (the curve 7) only fluorine has negative ionization potential and the following elements are arranged in its series accordingly:

fluorine - 5.11 eV, argon 2.2 eV, cobalt 4.5 eV, krypton 5.1 eV, rhodium 5.7 eV, xenon 6.7 eV, europium 6.7 eV, hafnium 6.8 eV (hafnium with the ionization potential 68 eV, is referred to osmium isobar, see the curve 3, Hf), thallium 6.9 eV, thorium 6.9 eV.

Oxygen (the curve 8) has negative ionization potential too. It is accordingly equal: oxygen - 15.76 eV, chlorine - 9.8 eV, iron - 4.8 eV (here iron, as well as oxygen, has negative ionization potential), bromine - 3.3 eV, ruthenium - 3 eV, iodine - 2,5 eV, samarium has already positive ionization potential and comes nearer to alkaline elements as to its properties. The potential value of ionization for samarium 4.6 eV, lutecium 5.1 eV, quicksilver 5.6 eV, actinium 6.1 eV, (see the curve 8).

Nitrogen has even more negative ionization potential:

nitrogen - 28.53 eV, sulfur - 22.4 eV, manganese - 16.6 eV, selenium - 12,75 eV, technetium - 10 eV (technetium differs from halogens of bromine and iodine a little as to its chemical properties, technetium features were discovered spectrographically in these halogens (especially in iodine) not incidentally.

The ionization potential of tellurium is the following: - 9.01 eV, promethium - 4.3 eV (this lanthanide appeared halogen), ytterbium 2.7 eV (ytterbium became alkali metals), gold 4.2 eV (others allotropic gold modifications have major ionization potential, which is equal +9.23 eV), radium 5.4 eV (see the curve 9).

Here we notice that the ionization potentials of all other series, including 12, cross a zero axis. These data are presented in the Fig. 1 b. Analyzing the chart of maximal thresholds of the ionization potentials of chemical elements, it is possible to detect the peculiar features in their natural structure. Carbon (graphite), phosphorus (black), chrome, arsenic (it is not determined yet, since it is chrome or molybdenum isobar), molybdenum etc. have positive and major ionization potentials, according to the curve 1 (Fig. 15).

Apparently it is explained by these atoms structure. As the atoms ionization potentials of the 1-st series differ from each other a little, so the cores of these elements are carbon-like. Perhaps, the black phosphorus,

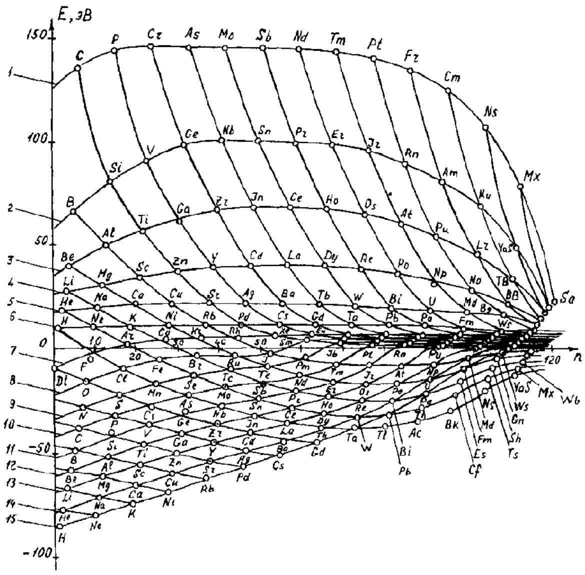

Figure 15: The interpolated ionization potentials of known as well as still unknown chemical elements

except other variants can have a structure of lithium carbide according to given habitues of nuclear crystals in specified elements series, for example:

$$P = LiC_2 = Li_3C. \tag{19}$$

Francium located in this series, is not found yet, since it represents the platinum isobar or thulium carbide

$$Fr = PtF = PtLi_3 = PtCLi = TmC_3 = $$
$$= NdCo = SbC_6 = MoRh = \ldots \tag{20}$$

Both maximum (Mx_{114}) and sadium (Sa_{123}) are similarly synthesized

$$Mx = PtC_6 = PtCrLi_4 = $$
$$= PtCrMg = PtKr = \ldots \tag{21}$$

In the second series, as well as in carbon, the elements with similar physicochemical properties are united. Really, boron properties were not stacked in frameworks of D.I. Mendeleyev's table, since they were close to silicon more, than to aluminum. In the chart (Fig. 16) the ionization potentials approach boron to silicon, than to aluminum. It's obvious that a silicon core contains a boron core, and it can be presented as the combination:

$$Si = BF = B_2Be = BLi_3 = CO. \tag{22}$$

And really, the combination BLi_3, have the ionization potential about 82 eV, i.e. approximately as much as silicon has. Accordingly vanadium is presented by the combinations:

$$V = SiLi_3 = BLi_6 = B_2Al = B_3O = $$

$$= B_4Li = CaLi = BC_3 = \ldots \qquad (23)$$

Other elements in this series are presented as well.

The ionization potential from prazeodium reduces in accordance with the elements number growth, coming nearer to a zero axis step-by-step. There are also 122, 131, 140, 149, 158 elements after 113 element (Yas) apparently.

In a beryllium series the elements have a beryllium beginning and each of them has a structure as beryllium combination with the previous elements. For example:

$$Al = BeF = BeLi_3 = Bbe_2 = BO. \qquad (24)$$

Paying attention to the izosteres (24), we shall remark, that oxygen and fluorine have negative ionization potential. Therefore any elements oxide of periodic system will have always smaller ionization potential, than the element ionization potential. For example, carbon has 140 eV, and carbon monoxide (CO), i.e. silicon izostere is only 82 eV. The silicon element has the same ionization potential. Precisely as well as aluminum, presented as izostere, i.e. boron oxide (Bo), has the ionization potential 48 eV. Accordingly sodium is presented as lithium oxide $Na = LiO$, potassium - as sodium oxide $K = NaO$, rubidium as copper oxide, and cesium as silver oxide.

Oxided hydrogen (HO) represents fluorine, and oxided fluorine is chlorine. In its turn oxided chlorine forms manganese $Mn = ClO$, and the chlorine dioxide forms arsenic and so on.

The genealogical system of elements formation by means of oxygen atoms joining can be determined in the chart (the Fig. 16) at once. It can be seen from the chart, that the carbon branch has major extent, as along the branches of fluorine cores joining (C, P, Cr, As, Moetc.), as well as along the branches of oxygen joining (C, Si, Ti, Zn, Sr, Pd etc.). And the branches do not cross a zero axis, but in accordance with the number increase they approach each other step-by-step. The branches of a boron, beryllium, lithium, helium, hydrogen, cross the axis, but with the element number increase their ionization potentials also come nearer to a zero point.

6. Periodicity of the ionization potentials table

The chart (Fig. 15) actually is the periodic law of chemical elements, which for general obviousness is depicted in the Table 1. 6 series of a zero axis (series H, He, Li, Be, In, C) are given in it. The zero deuteron series (element formed by proton and meson coupling, the charge of which is always equal to zero point, but it has positive and negative ionization potential).

Insert Table 1

In a zero series have come
$Dt, Ne, Ar, Ni, Kr, Pd, Xe, Gd, Hf, Pd, Th, Fm, Gn...$

Perhaps, the elements of this series contain deuterons and differ by higher inertness at the expense of it.

The horizontal deuteron series includes fluorine halogen and elements, related to fluorine: $Ar = F2$; $Co = F_3$; $Kr = F_4$; $Rh = F_5$; $Xe = F_6$ etc. - known still with positive ionization potentials. Halogens can be the whole zigzag elements succession.

$H^1, F, Cl, Co, Br, Rh, J, Eu, Lu, Tl, Ac, Es, Sh,$
where Co, Rh, Eu, Lu, Tl, Ac, Es, Sh are izosteres.

This halogen series will be opened completely in some time. If we pay attention to the following oxygen series:

$O, Cl, Fe, Br, Ru, J, Sm, Lu, Hg, Ac, Cf, Sh,$
we shall notice, that three halogens (Cl, Br, J) have the same ionization potentials on the chart (Fig. 16), as fluorine has. However, after iodine the curve of ionization potential crosses a zero axis and the samarium appears alkaline element already, as well as all known lanthanides. But izosteres $Fe = CIF$; $Ru = BrF$; $Sm = IF$ etc. will be strong oxidants.

If we pay attention to the first and second series of the chart (Fig. 16), we shall notice, that they contain all alkaline elements (H, Na, K, Cu, Rb, Ag, Cs, Tb, Ta, Bi, Pa, Md, Ws). The alkaline elements are also the elements of the second series, such, as Ca, Sr, Ba, W, U, Bg, as they have the same cores structure, as sodium and copper have.

Francium and gold are out of these series. But they are still alkaline. Really, if to pay attention to an oxide series, beginning with phosphorus (P, V, Ga, Ag, Cs, Eu, Lu, Au, Fr, Am, Lr, Bb), so gold and francium drop up to the level of ionization potential of alkaline elements, which is even lower than cesium, europium, lutecium.

Thus, the periodic law, presented by the Table 1, has more physical sense, than D.I. Mendeleyev's table.

There is a nitrogen series after an oxygen series:
$N, S, Mn, Se, Tc, Te, Pm, Yb, Au, Ra, Bk, Ts.$

If to pay attention to a core structure of this series, it is possible to remark, that all of them are related to nitrogen. For example, the line of nitrogen radiating $337Nm$ is the absorption line for selenium, gold, and manganese has related coloring ions with iron, cobalt, nickel and copper along the vertical, and with technetium, promethium and gold along the horizontal. And promethium is one of lanthanides having the most strong halide properties after iodine. Therefore it is difficult to separate it out of other elements, as technetium. It was possible to detect spectral lines of nonradioactive promethium on a tungsten wire working on iodine clearing for a long time. Non-radioactive technetium should be searched also among bromine, iodine, selenium, tellurium, and other elements of a nitrogen series.

Technetium (metal) is obtained in a fusion deuterium reaction at tritium disintegration, when molybdenum powder is used as solvent. Tritium causes molybdenum to throw hydrogen atoms to other cores at the disintegration according to the schema:

$$i \Rightarrow Mo_{96}^{42 \to H_{1-3}} \to +Mo_{96}^{42} =$$
$$= Nb_{93-99}^{41} + Tc_{97-99}^{43} + W; \qquad (25)$$
$$W = 2W_{Mo} - W_{Nb} - W_{Tc} = 2 \cdot 26.631 -$$
$$-25.94 - 27.325 = -0.003\ MeV = -3\ keV.$$

The energy of tritium disintegration has approximately the same level. Technetium halogen is obtained by separating from iodine neon core in the medium of a deuterium and tritium in an electric arc condition regime with formation of micropinch electric discharges by the currents up to $200 - 800kA$.

There is a carbon series following nitrogen. We have given elements of this series the same titles, as elements with positive ionization potential. If phosphorus, arsenic and antimony have negative ionization potential, so thulium with such properties is not found yet. Francium and nilsboron transfer to the side of elements with positive ionization potential (see the chart of the Fig. 15, the curve 10).

Negative ionization potentials have the elements of other series too. Certainly many of them are unknown, but the value of the proposed table consists also in that, which goes together with the chart (Fig. 16), that it demonstrates the search paths of many new elements with unknown properties until nowadays. D.I. Mendeleyev's table given the jerk for the unknown elements search at the beginning, then became a powerful barrier in the matter structure analysis.

We shall remark in the conclusion, that all halogens except of astatine and fluorine are in an oxygen series. It explains non-stable halogens couplings with oxygen. Fluorine with oxygen is strong oxidizing fluoride of oxygen OF_2, called as iron izoster, and applied for acidification of missile combustible.

All halogens, except of fluorine, exhibit a positive oxidizing extent in combinations with oxygen and it is stronger, than the element number is higher. It concerns quicksilver, actinium, californium, shulpinium also. As to astatine, its location in beryllium series (the curves 3 and 12) points the following ionization potentials for it accordingly : $+62eV$ and $-9,9eV$. In the first case astatine approaches to osmium isobar, and in the second case it approaches to halogen. Both stable astatine modifications are not found yet, though they are available in nature doubtless.

It is decomposed to the raster images. Let's consider a hydrogen atom as the raster image of the Universe part conditionally. If this presupposition is correct, so it will be possible to learn our Galaxy by the structure learning of hydrogen atoms. The hydrogen atoms are various, various are so called structures, representing composite atoms and being a prototype of the proximate territory of our Galaxy. That is why the atoms analysis is so important from the point of view of the Universe learning.

Therefore the proposed table of izosters reveals the substance structure on one hand, and it allows to look into the Universe depths on the other hand.

The proposed elements system began to be called as "physicochemical table by Bolotov" (Boris Vasilievich Bolotov, Maxim Borisovich Bolotov, Nelly Andreevna Bolotova) after its defending at the scientific council of Russian academy.

The first copy of the table is kept in the museum of the academician N.D. Zelinsky in Moscow in Belinsky street. If to pay attention to the Table 1 from the point of view of inertness reducing, for example, beginning from carbon, so we discover, that carbon itself (as well as graphite and diamond) has the best inertness. Really, carbon is diluted in no acid, including nitrohydrochloric acid and etching acid. The complete ionization potential comes nearer to 138 eV. Silicon follows carbon along the diagonal in the table (ionization potential is about 82 eV), then there is a titanium (57 eV), then zinc (38 eV), strontium (22 eV), palladium (12 eV), xenon (6.7 eV), samarium (4.6 eV), ytterbium (2.7 eV), platinum (1.8 eV), plutonium (1.3 eV). In this series the inertness as though has shot many inert substances known by us.

Now let's speak about all possible izosters arranging in the table. If to take a carbon series, so we shall remark, that 17 elements from carbon to chrome should be arranged (18th should be chrome). Really, carbon resembles a cube as to its structure, which has 6 edges (Fig. 15, a). If one more hydrogen atom can be joined to a cube (as it is made in the Fig. 15, c), so it appears, that not nitrogen is formed at such coupling, which will have 14 nucleons, but carbon too, but with 14 nucleons and 7 hydrogen atoms. Such carbon resembles soft graphite.

If to join one more hydrogen atom to carbon (Fig. 15, c) on a free edge, so carbon, instead of oxygen is formed again, this has the same number of nucleons. Really carbon similar to graphite is formed again, but with even softer structure approaching to resins.

In other words, the further hydrogen atoms joining to a cube edges will form graphite-like substances, including fluid and even gaseous ones. In total it appears 17 new izosters from carbon to chrome can be formed, the properties of which transfer from graphite to chrome step-by-step.

17 new izosters and so on are arranged and 102 elements can be obtained from chromes to molybdenum per a series also. 108 elements are arranged in this series as a whole. There are twelve series, as it can be seen from the table 2. Hence, only 1296 elements

are arranged in the specified series. Now we shall pay attention to a the table diagonal and we shall detect, that there is a gap composed of eight elements between carbon and silicon. It occurs, that there should be 96 horizontal series, but not 12.

7. Conclusion

Hence, total amount of izosters is 10368 in the specified table, i.e. 10 thousand, and there are only 105 in D.I. Mendeleyev's elements table. In other words, D.I. Mendeleyev's table has concealed a hundred times more elements from the scientific world, than it has opened. Certainly, it is not the limit for the proposed table since izosters opportunities are more than presented here. But the table gives a good background for practical activity in the field of cold nuclear fusion and cores dividing as a whole.

References

[1] B.V. Bolotov, N.A. Bolotova, M.B. Bolotov. "The physicochemical table of a matter structure." Zaporozhie, Press of ZSIA, 1996, 110 pp. (In Russian).

[2] V.I. Goldanskij, V.V. Kuzmin. "Spontaneous infringements of mirror symmetry in the nature and an origin of life." *UFN*, V. 157, issue 1, January 1989, pp. 3–46. (In Russian).

[3] I.E. Zilberman, I.I. Polzikova, A.O. Raevskij. "Z" exchange resistive mechanism of amplification of spin waves in ferromagnetic semiconductors in a high-frequency electric field. *Letters in ZHETF*, V. 50, issue 6, pp. 284–286. (In Russian).

[4] A.I. Lazarev, I.I. Kharlamov. "Analysis of metals." (Handbook). Moskow, Metallurgy, 1987, p. 332. (In Russian).

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NON-EINSTEINIAN THEORY OF GRAVITY

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As is known general relativity theory (GR) is based on the so called equivalence principle according to which gravity is identified with accelerated frame and therefore both — acceleration and gravity — are described by means of metric given on the space-time continuum, i.e. by the Riemannien structure, given on pseudoeuclidean space of four dimension.
Here we demonstrate that at the elementary particle level (in the framework of quantized field theory) there is no equivalence between gravity and acceleration. As a result we may formulate the following statement: two particles with different masses (for example electron and proton) move in one and the same external gravitational field not identical. In connection with this we suggest another approach to the gravitation interaction problem, based on the deformation of hidden dynamical system — relativistic bi-Hamiltonian one for brevity called ether underlain the elementary particle theory.

1. Introduction

In articles about GR [1] Einstein had very often referred on two following circumstances: i) For any body its inertial mass m_i is equal to its gravitational one m_g, ii) In given gravitational field all bodies move identical. So that in particular at the motion in a homogeneous gravitational field all they will have one and the same acceleration (Galilean gedanken experiment). It permits at first sight to identify such a field with accelerated frame.

In connection with i) it has to indicate to the other obvious circumstance: mass of any body is made up from masses of elementary particles (nucleons and electrons) consisting it and their interactions. Hereby an elementary particle is characterized by only one mass m,which is calculated in the theory, see [2]. There is no another mass of particle (called m_g) and hence of body. Therefore in our opinion there is no indeed the problem of identity $m_i = m_g$, lying in the ground of so called equivalence principle.[3] Moreover, in [4] it is shown by means of the simple calculations in the framework of quantized field theory[4] that at the elementary particle level there is a renormalization of gravitational vertex that means the renormalization of Newtonian constant of gravitational interaction γ. As a result the latter begins to depend on mass of particle which moves in the field. Therefore for example electron and proton (or neutron) will move in it by the different way. Universality of motion (universality of space and geometry) is not indeed. This means that it is impossible to reduce the gravity to the metric and curvature of space-time: at elementary particle level there is no equivalence principle. Therefore we consider that the metric approach to gravity is not adequate.

It is important to understand that reducing of gravity to the space geometry does not permit us to discover the true nature of this kind of interaction. In our opin-

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[3]In connection with this we would like to emphasize: from pure logical point of view equivalence principle (formulated as "gravity = space metric or coefficients of affine connectedness or space curvature") does not follow from the equality $m_g = m_i$ (see also Fock's criticism of equivalence principle in [3]). We would like to add else that if gravity = metric so generally speaking metric $\neq$ gravity (for example, the Poincare-Minkovski metric is not gravity), i.e. from mathematical point of view equivalence principle is not equivalence at all (there is no symmetry!). Moreover as is known locally gravity may be avoided, but curvature is never.

[4]Hereby it is very important to inquire into the problem: at what level (classical or quantum) gravitational interaction is switching on. Physical meaning and mathematical tool depend on this.

As is known first phenomenological theory of gravity was given by Newton without explanation the physical nature of gravitational force. GR considers that the reason is in the Riemannian geometry.

We consider nevertheless that the metric and gravity are quite different things: the first is connected with *co-tangent fibration* of the space-time, while the second is connected with the so called *material one*. More over to apply a quantization procedure to the metric (and to identify this with *space quantization*) makes no sense: metric is not characterized by energy-momentum tensor [1], therefore from physical point of view quantum of metric is a bad defined notion.

ion it hides in properties of physical substance which causes the existence of space-time as well as fundamental particles with all their inner properties and interactions. For a long time it is called as ether however in the beginning of the 20 century it was (by mistake of course) rejected from physics.

Here we first of all try to answer the question lying in the ground of equivalence principle: whether indeed different particles move in given gravitational field by identical way or not? As the answer turns out negative we will further formulate a new approach to the gravity based on the notion of deformation of ether field lying in the ground of elementary particle theory suggested in [2].

2. Galilean experiment with elementary particles

1. In quantum theory gravitational interaction process is described by the Lagrangian $h_{\mu\nu}(X)\, T_{\mu\nu}(X)$, where $h_{\mu\nu}(X)$ is the external gravitational field and $T_{\mu\nu}(X)$ is the energy-momentum tensor built from particle field operator $\psi(X)$. This is shown in the Feynman diagram a (see Fig. 1)

Further we are interested in the case of zero transferred momentum *k=0* only.[5]

If a particle is charged (like electron or proton) it is necessary of course to take into account electromagnetic radiative corrections [4] described by Feynman diagrams *b, c, d,* where wavy lines represent virtual photon from own electromagnetic field of particle. (Graphs *b, c* look like the Schwinger's effect containing the anomalous magnetic moment and renormalization of electric charge, graph *d* is described the interaction of photon with gravitation field). In our case all these effects lied to the renormalization of gravitational vertex or to the renormalization of the Newtonian constant γ.

Proceeding from general reasoning we may write for renormalized Newtonian constant γ' the following expression

$$\gamma' = \gamma\left(1 - \frac{\alpha}{\pi} f\left(m^2\right)\right),$$

see below, where γ is the "bare" constant defined further (see formula (21)) and $\alpha = \frac{e^2}{4\pi}$ is the Sommerfeld fine structure constant (note: at the gravitational vertex coupling constant $\sqrt{\gamma}$ stands). Function *f* depends on mass of particle and its spin only. Namely γ' is experimentally observed quantity.

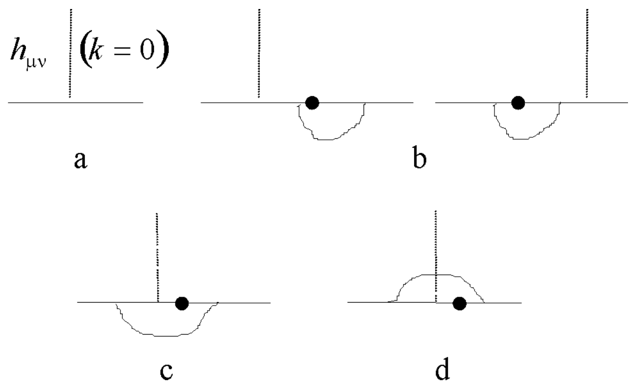

Figure 1: Feynman diagram

In the framework of the local interaction theory to calculate *f* is impossible because ultraviolet divergences are present in the theory [6]. But we use a new (if it may be said) improved quantized field theory of interaction, see [2], in which particle is non-point, smearing object describing by the bilocal field $\psi(X, Y)$ (here X_μ are usual space-time coordinates and Y_μ are inner coordinates describing the spatial structure of particle). Interaction of such a particle is described by usual Feynman diagrams in which at vertex there is a form-factor $\rho(p, k)$ shown in Fig. 1 by a dark spot. In the case of massive particle (for example, electron) interacting with zero mass particle (photon) $\rho(p, k)$ has the form $\rho(p, k) = \theta(I)\,\frac{\sin\sqrt{I}}{\sqrt{I}}$, where $I = (pk)^2 - p^2k^2$ and θ is the Heaviside function. As a result all Feynman's diagrams become convergent, see [4].

Contribution from diagrams *b, c* into *f* is found in [4] and equal

$$\int_0^1 dz\left[2z(1-z)\, K_0\left(m^2 z\right) + \frac{2}{3} m^2 z^2 (1+z)\, K_1\left(m^2 z\right)\right],$$

where K_n are the Mac-Donald's functions. Contribution from diagram *d* is

$$\int_0^1 dz\,(1-z)\left[K_0\left(m^2 z\right) - \frac{1}{3} m^2 z K_1\left(m^2 z\right)\right].$$

In the sum we have for $f\left(m^2\right)$:

$$f\left(m^2\right) = \int_0^1 dz\left[(1-z)(1+2z)\, K_0\left(m^2 z\right) + \right.$$
$$\left. + \frac{1}{3} m^2 z\left(2z^2 + 3z - 1\right) K_1\left(m^2 z\right)\right].$$

[5] Note that in this item our description of gravitational interaction coincides with quantum version of GR linear approximation elaborated by Bronstein, Ivanenko, Gupta and others (see [5]). As is known this kind of interaction is non-renormalizable (to the point strong particle interaction is non-renormalizable too, [2]). In local theory (point-like particles) where there are divergences usually one avoids the consideration of such a type of interactions. But in a non-local field theory (bilocal fields, smearing particles) such interactions have all rights to be considered (see below).

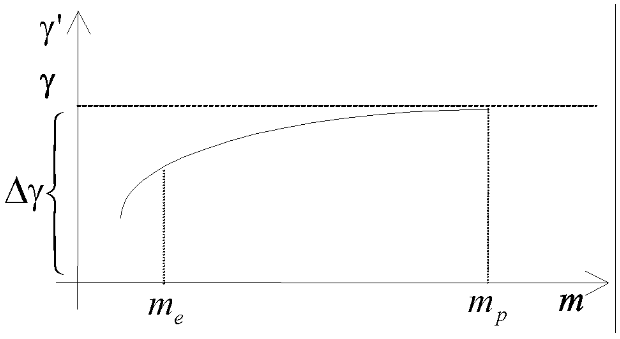

Figure 2: Dependence of γ' on particle mass

In the case of small masses $m << 1$ (here $\frac{mc}{kh}$ is a dimensionless mass; in the theory there are three fundamental constants c, h, k, [2]) we have

$$f\left(m^2\right) = \frac{1}{12}\left(17 + 10\ln 2 - 10C\right) - \frac{5}{6}\ln m^2$$

(C is the Euler constant). For example for electron its dimensionless mass is $\frac{m_e c}{kh} = 0.5 \cdot 10^{-3}$ ($khc = 1$) GeV, for proton we have $\frac{m_p c}{kh} = 0.938$.

In another limit $m \to \infty$ we have $f\left(m^2\right) = \frac{\pi}{3m^2}$ and we may consider the correction to be zero.

So we see that particles with different masses are characterized by different Newtonian constants γ' depending on mass of particle. Namely renormalized constant goes into all experimentally observed effects. Dependence of γ' on particle mass is shown in Fig. 2

Obviously we have the following expression for difference $\Delta\gamma = \gamma_p' - \gamma_e'$ between γ's for proton and electron

$$\Delta\gamma = \gamma\frac{5\alpha}{3\pi}\ln\frac{m_p}{m_e} = \varepsilon\left(p, e\right)\gamma,$$

where $\varepsilon\left(p, e\right) = \frac{5\alpha}{3\pi}\ln\frac{m_p}{m_e} = 3 \cdot 10^{-2}$.[6] It follows from here: *electron interacts with gravitational field weaker than proton* (we did not take into account strong interaction of proton yet!). This circumstance is expressed in the character of electron motion in comparison with proton, namely, in time delay.

2. With this aim we consider the simplest case of free falling charged particle in homogeneous gravitational field of the Earth. To estimate macroscopic time delay we can use the classical non-relativistic formulas in particular the formula for passed path $l = \frac{g't^2}{2}$ where $g' = M_E\gamma'/R_E^2$ (M_E, R_E are mass and radius of the Earth).[7] For passing one and the same path l electron and proton demand different times t_e and t_p correspondingly. Hereby the difference $\Delta t = t_e - t_p = \frac{\Delta g t_p}{2g_p} = \varepsilon\left(p, e\right)\sqrt{\frac{l_p}{2g_p}}$. At free falling an electron will come off from proton in the distance $\Delta l = l_p - l_e = \frac{\Delta g t_p^2}{2} = \varepsilon\, l_p$. These differences might be compensated by the initial velocity of electron introducing in the formula $\frac{g_p' t_p^2}{2} = \frac{g_e' t_p^2}{2} + v_e t_p$. Hereat v_e is equal $v_e = \frac{\varepsilon}{2}\sqrt{\frac{g_p l_p}{2}}$. If $l_p = 10^2$ cm, $g_p = 10^3$ cm/s^2 so $t_p = 0.44$ s. In this case differences in time and distance are correspondingly $\Delta t = 6 \cdot 10^{-3}$ s and $\Delta l = 3$ cm. Hereby initial velocity of electron must be $v_e = 3.3$ cm/s.

So, we may conclude: at quantum (micro) level equivalence principle is invalid. In connection with this it very interesting to carry out the Galilean experiment at the elementary particle level with electrons and protons.

[6]For comparison, for ones and the same particles (neutrons) in dependence on their energy ($k \neq 0$) the magnitude $\Lambda\gamma/\gamma \approx 2 \cdot 10^{-3}$, see [7].

[7]It is well known that at $l >> \left(\frac{h^2}{m^2 g}\right)^{1/3}$ (for electron the latter magnitude is 0.1 cm) the motion may be considered to be quasiclassical one, see [8].

3. New theory of gravity

Proceeding from the obtained result we have to look for an another physical principle for description of gravity at elementary particle level.[8] This principle we consider is already found. It is ether — hidden dynamical system underlain new elementary particle theory.

However the situation about ether is very complicated. First of all, we would like to recall that in the beginning of 20 century it was rejected from physics. But Newton, Maxwell, Lorentz considered that ether is very useful and necessary physical substance which causes all properties of observed world. Soon after this in connection with the problem of physical space-time ether was introduced again. But it has been identified with metric $g_{\mu\nu}$ of space-time continuum. So according to GR we have

ether = metric = gravity

We have to pay attention, that in GR metric is created by observed matter. Hence the ether is created by observed matter too. It is typical confusion of ideas, not admitted indeed.

Meantime, there is already ready mathematical theory in which the ether is a special entity, underlain the elementary particle level and observed world. In the theory the ether is the bi-Hamiltonian dynamical

[8]If we would not be based on this result sure there is the necessity in a new theory of gravity because in GR gravity is identified with space (with its metric). However it is desirable from the beginning to fasten gravity to matter but not to space (geometry). Without matter (more exactly pre-matter) there is no gravity (but according to the GR it is). Another words matter is primary, space (and gravity) is second given rise by matter (Leibniz). According to GR all is quite the apposite: gravity (=space) gives rise matter (at quantum level). In connection with this see [10].

system hidden in the isolated point of space-time discontinuum and described by *non-Lagrangian field f(x)* grown from the point [9]. This dynamical system is the base of elementary particle existence and arising of all their interactions [2].

1. In new theory *gravity is originated from flexibility(elasticity or degeneration) of field $f(x)$ which described by deformation of its coordinates x_μ written in the form:*

$$x_\mu \to x'_\mu = x_\mu + a_\mu(x)\,. \tag{1}$$

Non-deformed ether field $f(x)$ obeys the equation [9]

$$p_\mu \frac{\partial}{\partial x_\mu} f(x,\varphi) = 0. \tag{2}$$

It is the master equation of ether, solution of which is written in the form [2,9]

$$f(x,\varphi) = e^{ipx} f_0(\varphi)\,. \tag{3}$$

Here $p_\mu = \bar{\varphi} \overset{+}{\underset{\mu}{\sigma}} \varphi$ ($p^2 = 0$, $p_0 = \bar{\varphi}\varphi > 0$ the latter is very important property of ether, see [9]) is 4-momentum of ether quantum f (x_μ, p_μ are variables inside the point, φ is own variables of ether).

Obviously, at deformation (1) ether field becomes

$$f'(x,\varphi) = e^{ipa(x)} f(x,\varphi) \tag{4}$$

and obeys the equation [10]

$$p_\mu \frac{\partial}{\partial x_\mu} f'(x,\varphi) = i h^{(0)}_{\mu\nu}(x)\, T^{(f)}_{\mu\nu}(x)\,, \tag{5}$$

where

$$T^{(f)}_{\mu\nu}(x) = p_\mu p_\nu f'(x,\varphi) \tag{6}$$

is *symmetric* energy-momentum tensor of ether quantum f and

$$h^{(0)}_{\mu\nu} = \frac{1}{2}\left(\frac{\partial a_\mu}{\partial x_\nu} + \frac{\partial a_\nu}{\partial x_\mu}\right) \tag{7}$$

is a symmetric tensor field playing the role of gravity.

As ether deformations take place in the point (in the fiber, where there is only vertical motion), only "transversal" deformations $a_\mu(x)$ are considered. They obey the "Lorentzian" gauge $\frac{\partial a_\mu}{\partial x_\mu} = 0$ and, hence, the spur of $h^{(0)}_{\mu\nu}$ is equal zero

$$h^{(0)}_{\mu\mu} = 0. \tag{8}$$

As these deformations are spontaneous, they have no sources. Therefore D'Alambertian is zero $\Box a_\mu(x) = 0$ and conditions

$$\frac{\partial}{\partial x_\nu} h^{(0)}_{\mu\nu} = \frac{1}{2}\left(\Box a_\mu + \frac{\partial}{\partial x_\mu}\left(\frac{\partial a_\iota}{\partial x_\nu}\right)\right) = 0 \tag{9}$$

are fulfilled. These conditions play the very important role in the theory (see further).

Obviously, symmetric tensor $T^{(f)}_{\mu\nu}(x)$ (6) satisfies all these conditions too:

$$T^{(f)}_{\mu\mu} = 0, \quad \frac{\partial T^{(f)}_{\mu\nu}}{\partial x_\nu} = 0. \tag{10}$$

Further we may go over from $h^{(0)}_{\mu\nu}$ to the more general functions $h_{\mu\nu}$ (or $\tilde{h}_{\mu\nu} = h^{(0)}_{\mu\nu} + h_{\mu\nu}$; $h_{\mu\nu}$ unlike $h^{(0)}_{\mu\nu}$ may be variated) conserving all these conditions and having sources. Hereby the integral $\tilde{a}_\mu = \int_\Gamma^x h_{\mu\nu} dx_\nu$ will depend on final point x and else on contour Γ coming in x. (It is interesting to notice that since the space of coordinates x is a vector space so the exact forms exhaust all closed differential forms on it: it is the well known Poincare lemma, see for example [11]). Due to the Stocks theorem we may write

$$\oint_\Gamma h_{\mu\nu} dx_\nu = \int_S h_{\mu[\nu\rho]} dS_{\nu\rho}, \tag{11}$$

where S is a surface limited by the closed contour Γ and $dS_{\nu\rho} = dx_\nu \wedge dx_\rho$ ($\wedge$ is external multiplication). So we come to the tensor $h_{\mu[\nu\rho]} = \frac{\partial h_{\mu\nu}}{\partial x_\rho} - \frac{\partial h_{\mu\rho}}{\partial x_\nu}$, hereat $h^{(0)}_{\mu[\nu\rho]} = \frac{1}{2}\frac{\partial}{\partial x_\mu}\left(\frac{\partial a_\nu}{\partial x_\rho} - \frac{\partial a_\rho}{\partial x_\nu}\right)$. Functions $h_{\mu\nu}$ and $h_{\mu[\nu\rho]}$ are called to be potentials and strengths of gravity correspondingly. Obviously the Bianchi identities take place: $h_{\mu[\nu\rho]} + h_{\nu[\rho\mu]} + h_{\rho[\mu\nu]} = 0$ and also $\frac{\partial h_{\mu[\nu\rho]}}{\partial x_\sigma} + \frac{\partial h_{\mu[\rho\sigma]}}{\partial x_\nu} + \frac{\partial h_{\mu[\sigma\nu]}}{\partial x_\rho} = 0$.

2. As usually equation (4) describes only *perception process* of gravity (term $h^{(0)}_{\mu\nu}(x)\, T^{(f)}_{\mu\nu}(x)$).There is no equation of the type $h^{(0)}_{\mu\nu} = \gamma T^{(f)}_{\mu\nu}$ yet, which describes the *creation process* of gravity, because for fields *f(x)* there is no Lagrangian [9].

However if to build coherent state

$$\varphi(x) = \int f(x)\; d\mu_f(\varphi)$$

from ether fields $f(x)$, integrating over own variables φ with measure $d\mu_f(\varphi)$ (details see in [2]), we get the field with zero mass and positive energies only (such an entity is not quantized), for which there is already Lagrangian in the form

$$L_\varphi = \frac{i}{2}\left(\bar{\varphi}\overset{+}{\sigma}_\mu \frac{\partial}{\partial x_\mu}\varphi - \left(\frac{\partial}{\partial x_\mu}\bar{\varphi}\right)\overset{+}{\sigma}_\mu \varphi\right) \tag{12}$$

(in the case of spin 1/2) or in the form $L_\varphi = \frac{\partial \bar{\varphi}}{\partial x_\mu}\frac{\partial \varphi}{\partial x_\mu}$ (in the case of zero spin).

From coherent state point of view *ether is two component gas: spinor and scalar. This gas is a pre-matter from which our Universe consists of before the first Big Bang.*

Equation for spinor states φ is

$$\overset{+}{\sigma}_\mu \partial_\mu \varphi = 0 \tag{13}$$

(here $\partial_\mu = \partial/\partial x_\mu$). It looks like the well known Weyl equation, although here φ is not neutrino field but coherent state of ether is. At ether deformation this equation transits into the equation with interaction

$$\overset{+}{\sigma}_\mu \partial_\mu \varphi = h^{(0)}_{\mu\nu} \overset{+}{\sigma}_{(\mu} \partial_{\nu)} \varphi, \tag{14}$$

here $\overset{+}{\sigma}_{(\mu}\partial_{\nu)} = \frac{1}{2}\left(\overset{+}{\sigma}_\mu \frac{\partial}{\partial x_\nu} + \overset{+}{\sigma}_\nu \frac{\partial}{\partial x_\mu}\right)$ (compare with (4), (skew symmetric part, due to the condition $\left(\overset{+}{\sigma}_\mu \frac{\partial}{\partial x_\nu} + \overset{+}{\sigma}_\nu \frac{\partial}{\partial x_\mu}\right)\varphi \approx (p_\mu p_\nu - p_\nu p_\mu)\varphi = 0$, see [12], does not work)). Hereby, the interaction term $L_i = -h^{(0)}_{\mu\nu} T^{(\varphi)}_{\mu\nu}$ arises in Lagrangian, where energy-momentum tensor is (in the case of spin 1/2)

$$T^{(\varphi)}_{\mu\nu} = \frac{i}{2}\left(\bar{\varphi}\overset{+}{\sigma}_{(\mu}\partial_{\nu)}\varphi - \partial_{(\nu}\bar{\varphi}\overset{+}{\sigma}_{\mu)}\varphi\right). \tag{15}$$

So, field system $\{\varphi, h\}$ is *quasi-Lagrangian* (canonical momentum of this system is $\left\{\bar{\varphi},\ \frac{c^2}{8\pi\gamma}\left(\frac{\partial h_{\mu\nu}}{c\partial t} - \frac{\partial h_{\mu 0}}{\partial x_\nu}\right)\right\}$) and we may close it adding to the Lagrangian $L_\varphi + L_i$ the Lagrangian L_h of gravitational field $h_{\mu\nu}$. Hence total Lagrangian is $L = L_\varphi + L_i + L_h$. In the case of small and slowly changed functions $h_{\mu\nu}$ we can write Lagrangian L_h in the form of gauge invariant quadratic form $L_h = -\frac{c^3}{16\pi\gamma} h^2_{\mu[\nu\rho]}$ and action as integral $A = \int L\, d^4x$.[9] Here

$$\gamma = \nu^2 \frac{c^3}{hk^2} \tag{16}$$

is the Newtonian constant of gravitational interaction [10,13].

In the theory there are three fundamental constants: c (light velocity), h (Planck constant) and k (universal wave number). They are proper characteristics of ether. In (21) dimensionless normalization constant $\nu^{-1} = 9^{20}$ is the number of mapping of the set from *20* elements $h_{\mu[\nu\rho]}$ into the set from *9* elements $h_{\mu\nu}$ [10,13]. As $\nu/k = l_{Pl} \approx 10^{-33} cm$ is the Planck length, so $k \approx 10^{14} cm^{-1}$ (as before we put further *c=h=k=1*).

Further varying total Lagrangian over $h_{\mu\nu}$ we get the equations

$$\frac{\partial h_{\mu[\nu\rho]}}{\partial x_\rho} = \Box h_{\mu\nu} - \frac{\partial^2 h_{\mu\rho}}{\partial x_\nu \partial x_\rho} = 4\pi\gamma T^{(\varphi)}_{\mu\nu} \tag{17}$$

[9]Strictly speaking coordinates $x_\mu (= d\bar{X}_\mu$, see further) in the fiber (inside the point of discontinuum) are not measurable magnitudes, see [2]. Therefore the Stocks formula (14) as well as differentiating procedure make no sense and we may use only the set theoretical analog of these procedures: concrete $h_{\mu[\nu\rho]}$ may be obtained from $h_{\mu\nu}$ by means of $\nu^{-1} = 9^{20}$ mappings. So $h_{\mu[\nu\rho]}$ enters in (14) and in L_h with weight 9^{20}.

describing creation process of gravity. We think, the physical meaning of new theory is, first of all, in the possibility to determine numerical value of the Newtonian constant γ.

From explicit form of L_h the following expression for energy-momentum tensor $T^{(h)}_{\mu\nu}$ of gravitational field $h_{\mu[\nu\rho]}$ follows[10]

$$T^{(h)}_{\mu\nu} = \frac{1}{4\pi\gamma}\left(h_{\rho[\sigma\mu]}h_{\rho[\sigma\nu]} - \frac{1}{4}\delta_{\mu\nu} h^2_{\rho[\sigma\tau]}\right). \tag{18}$$

It satisfies the condition $T^{(h)}_{\mu\mu} = 0$. If to add to the quadratic Lagrangian L_h Lagrangian of the third degree $L'_h = -h_{\mu\nu}T^{(h)}_{\mu\nu}$ we get instead of(27) the equation

$$\frac{\partial h_{\mu[\nu\rho]}}{\partial x_\rho} = 4\pi\gamma\left(T^{(\varphi)}_{\mu\nu} + T^{(h)}_{\mu\nu}\right)$$

(hereby we neglect the contribution from L'_h into left hand side of this equation). From the equation conservation law

$$\frac{\partial}{\partial x_\nu}\left(T^{(h)}_{\mu\nu} + T^{(\varphi)}_{\mu\nu}\right) = 0 \tag{19}$$

follows automatically. It follows from (27) that $\frac{\partial}{\partial x_\nu} T^{(h)}_{\mu\nu} = T^{(\varphi)}_{\rho\sigma} h_{\rho[\sigma\mu]}$. Obviously for the field $h^{(0)}_{\mu\nu}$ without sources tensor $T^{\left(h^{(0)}\right)}_{\mu\nu} = 0$.

It has to pay attention that in the first approximation the right hand side of equation (27) there is not the tensor $T^{(h)}_{\mu\nu}$. And if the pre-matter would be absent ($T^{(\varphi)}_{\rho\sigma} = 0$) so the gravitational field $h_{\mu\nu} = 0$ and hence $T^{(h)}_{\mu\nu} = 0$. Therefore in the suggested theory gravity may be created by pre-matter (matter) only and it does not exist without matter. (Thus in the theory the Leibnizian principle takes place; compare with GR where there are gravitational fields without matter). It is very important property of the scheme.

It is very important to emphasize that as quanta f and their coherent states φ are c-number fields (see [9]) so gravitation $h_{\mu\nu}$ is a c-number field too. So at the ether level gravity is a pure classical phenomenon.

3. After irreversible quantum transition $f \to \dot{f}$, taking place in the bi-Hamiltonian system, Lagrangian fields $\psi(X, Y)$ of fundamental particles arise (here $\dot{f}$ is the second component of the bi-Hamiltonian system), see [9].

[10]For comparison we set out the connection between the Riemannian structure and gravity, considering $g_{\mu\nu} = \delta_{\mu\nu} + 2h_{\mu\nu}$, where $h_{\mu\nu}$ are small and obeying the conditions (10) and (7): Christoffel symbols $\Gamma_{\mu,\nu\rho} = h_{\rho[\mu\nu]} + \partial h_{\mu\nu}/\partial x_\rho$, Lagrangian $L = -\frac{1}{16\pi\gamma}\left[h^2_{\mu[\nu\rho]} - (\partial h_{\nu\rho}/\partial x_\mu)^2\right]$, energy-momentum pseudotensor $t_{\mu\nu} = T^{(h)}_{\mu\nu} - \frac{1}{4\pi\gamma}\left[2\frac{\partial h_{\rho\sigma}}{\partial x_\mu}\frac{\partial h_{\rho\sigma}}{\partial x_\nu} - \delta_{\mu\nu}\left(\frac{\partial h_{\rho\sigma}}{\partial x_\alpha}\right)^2\right]$ (hereby h is doubled gravitational field). We see that the Riemannian structure of space-time is more general one than gravity of matter: the first has more canals of excitation, where energy may enter, than the gravitational ones.

Of course, ether deformation is transferred from field $f(x)$ onto transition matrix elements $\left\langle \dot{f}(\dot{x}), f(x) \right\rangle$ (definition see in [2]) and particle fields $\psi(X,Y)$, $\left(X = \frac{1}{2}(x+\dot{x}), Y = \frac{1}{2}(x-\dot{x})\right)$. (Here we do not take into account the gravity generated by field $\dot{f}(\dot{x})$; strongly speaking particle fields ψ participate in two kind of gravity originated from f and $\dot{f}$). Not difficult to obtain equations for these fields ψ

$$\left(\Gamma_\mu \partial_\mu + M\right)\psi = h_{\mu\nu}\Gamma_{(\mu}\partial_{\nu)}\psi, \tag{20}$$

(here $\partial_\mu = \partial/\partial X_\mu$) following from the explicit form of matrix elements, and to construct the energy-momentum tensor for these fields

$$T^{(\psi)}_{\mu\nu} = \frac{i}{2}\left[\bar{\psi}\Gamma_{(\mu}\partial_{\nu)}\psi - (\partial_{(\nu}\bar{\psi})\Gamma_{\mu)}\psi\right], \tag{21}$$

which creates the gravity field $h_{\mu\nu}$ by means of equation (compare with (27))

$$\Box h_{\mu\nu} = 4\pi\gamma T^{(\psi)}_{\mu\nu}. \tag{22}$$

It follows from here that a point-like particle in rest ($T_{00} = M\delta^3\left(\vec{X}\right)$) creates the Newtonian field (potential) $h_{00}\left(\vec{X}\right) = -\frac{\gamma M}{|\vec{X}|}$.

As Lagrangian (elementary particle) fields ψ are q-number quantities so $h_{\mu\nu}$ in (22) must be q-number quantity too. Hence at the elementary particle level gravity is quantized. Note that interaction of bilocal fields does not contain ultraviolet divergences [4].

We see that the gravitation interaction of observed matter is caused by gravity of ether.

It is seen also, that for description of gravity at the ether level the *theory of deformation* (see for example [14]) applied to the ether medium is used. Note, that this theory deals with *linear* differential forms only. Hence our approach is principally distinguished from GR one, using *quadratic* differential forms and Riemannian geometry.

Now, proceeding from equations (20) and using the standard "averaging technique" we may obtain gravity equations at the macro level. Important question is: what is connection these equations with equations of GR?

First of all, it should be emphasized that in the suggested theory the case of strong (non-linear) gravitational fields $h_{\mu\nu}$ is connected with consideration of arbitrary Lagrangians L_h, but not Hilbert-Einstein Lagrangian - scalar curvature R. In the given form new theory is a linear approximation of GR.

4. It turns out, besides the elementary particles and their interactions ether is responsible also for creation of space-time continuum. Individual quanta f are responsible for particles arising. But ether in whole (as an ensemble of quanta *f)* is else a source of space-time continuum [10].

First this continuum arose before the first Big Bang. In the theory the latter is identified with total *irreversible* quantum transitions $f \to \dot{f}$ (the theory of bi-Hamiltonian system is non-unitary; from here time arrow originates). It is remarkable, that *ensemble* of quanta f is characterized by *macroscopic* energy-momentum tensor $\bar{T}^{(f)}_{\mu\nu}\left(\bar{X}\right)$ (definition see in [10], it is a common hydrodynamical tensor), principally distinguished from *microscopic* one $T^{(f)}_{\mu\nu}(x)$ (6) or $T^{(\varphi)}_{\mu\nu}(x)$ (18). This tensor generates absolute Newtonian space-time continuum (space-time filling by ether; $\bar{X}_\mu$ are coordinates of this space [10]). Remarkable, that its metric $g_{\mu\nu}\left(\bar{X}\right)$ and curvature $R_{\mu\nu\rho\sigma}\left(\bar{X}\right)$ are determined by exactly the Hilbert-Einstein equations. In the theory space-time continuum is appeared in the form of compact closed Friedmann manifold $S^3 \otimes R_1$ (or S^4). It is atlas of our Universe which is originated in the process of sticking together (see [10]) of local maps which are Poincare-Minkovski space-time $A_{3,1}$ with coordinates $x_\mu \left(= d\bar{X}_\mu\right)$ [11] (the set of maps is a *differential system* in the sense of [15], the infinite small (indivisible) part of which is a speceuscula — non-measurable carrier space of the field $f(x)$). Spaceuscula is identified with the mini-map $A_{3,1}$ (maximal size of which is $\approx 10^{-8} cm$, [2]).

In the framework of the new theory the question about unification of gravitational field $h_{\mu\nu}(x)$ with metric field $g_{\mu\nu}\left(\bar{X}\right)$ raised by GR will probably have negative answer because it is obviously that $h_{\mu\nu}(x) \neq g_{\mu\nu}\left(\bar{X}\right)$ ($\Gamma_{\mu,\nu\rho} \neq h_{\rho[\mu\nu]}$, see footnote 10) and ether $\neq$ space-time. More over unlike gravity field $h_{\mu\nu}$ metric field $g_{\mu\nu}$ is not characterized by energy-momentum tensor [1]. This means that energy of metric field may not be localized and in particular to quantize the metric, identifying this procedure with space quantization, makes no sense.

In spite of this in the suggested theory all three famous phenomena (they are: motion of the Mercury perigee and deviation of light rays — they are gravity effects, and also red shift — it is metric effect)) are of course the same.

So, at the ether level two problems of fundamental importance are solved: switching on gravitational interaction (and also other kinds of interactions) at *micro* level and creation of the space-time continuum at *macro* level [12]. They are quite different things although gravity plays an important role in the forming of space-

[11] It is very important to emphasize that the space with coordinates X_μ in (20) and $\bar{X}_\mu$ in which elementary particles and macro objects exist is measurable: it is characterized by the Lebesgue measure. But as it was shown in [2] differentials dX_μ being uncountable set of points are non-measurable magnitudes. So existing inside the fiber form of matter (ether quantum) is non-measurable (immediately unobserved, unlike particles) entity. And spaceuscle as a manifold of coordinates $x_\mu (= dX_\mu)$ is non-measurable set too. So, the property of space to be measurable is appeared only at the observed matter level.

[12] Principal distinction between micro $T^{(f)}_{\mu\nu}(x)$ and macro

time continuum: it pastes together various maps $A_{3,1}$. In connection with this we can say that the GR is the theory of physical space-time originating (but not gravity). Hereby the GR is the main part of cosmological theory of our Universe.

References

[1] A. Einstein. "Selected Scientific Works." V. 1–2. — Moskow: Nauka, 1965, 1966.

[2] S.S. Sannikov-Proskurjakov. *Ukr. J. Phys.*, No. 1, p. 5–13, No. 8, p. 775–783 (2001); No. 10, p. 1019–1027 (2001); No. 1, p. 9–15 (2000); No. 7, p. 615–628 (2002).

[3] V.A. Fock. "The Theory of Space, Time and Gravity." — Moskow: Nauka, 1955.

[4] S.S. Sannikov-Proskurjakov, M.J.T.F. Cabbolet. *Rus. Phys. J*, No. 4, p. 81–86 (2001).

[5] S. Gupta. "Quantization of Gravitational Field." In "Modern Problems of Gravitation." — Moskow: Mir, 1961.

[6] A.I. Akhiezer, V.B. Berestetskii. "Quantum Electrodynamics." New-York, "Interscience Publ.", 1965, p. 868. S.S. Sannikov-Proskurjakov. *Ukr. J. Phys.*, No. 6, p. 639–642 (2000); No. 7, p. 778–780 (2000).

[7] J.W.T. Dabbs, J.A. Harvey, D. Paya, H. Harstmann *Phys. Rev.*, v. 139B, p. 756–760 (1965).

[8] L.D. Landau, E.M. Lifshitz. "Quantum Mechanics." — Moskow: Nauka, 1963.

[9] S.S. Sannikov-Proskuryakov. *Ukr. J. Phys.*, No. 6, p. 639–642 (2000); No. 7, p. 778–780 (2000).

[10] S.S. Sannikov. *Rus. Phys. J.*, No. 2, p. 106–115 (1995); No. 8, p. 72–82 (1996).

[11] V.I. Arnold. "Mathematical Methods in the Classical Mechanics." — Moskow: Nauka, 1979.

[12] L.H. Ryder. "Quantum Field Theory." Cambridge, London, 1985.

[13] S.S. Sannikov-Proskurjakov, M.J.T.F. Cabbolet. *Rus. Phys. J*, No. 12, p. 54–59 (2001).

[14] V.A. Dubrovin, S.P. Novikov, A.T. Fomenko. "Modern Geometry." — Moskow: Nauka, 1986.

[15] S. Sternberg. "Lectures on Differential Geometry." Inc., 1964.

$\bar{T}^{(f)}_{\mu\nu}(\bar{X})$ energy-momentum tensors consists in the following: at the reflection $p_\mu \to -p_\mu$ we have $T^{(f)}_{\mu\nu}(x) \to T^{(f)}_{\mu\nu}(x)$ while $\bar{T}^{(f)}_{\mu\nu}(\bar{X}) \to -\bar{T}^{(f)}_{\mu\nu}(\bar{X})$. In particular it follows from here that in anti-Universe gravity field is the same that Universe, but space has negative sign of curvature [10].

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THE MODEL FOR THE INTERIOR OF THE SUN

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The present paper outlines a model of the interior structure of the Sun. The systems of equations describing the inner structure are integrated using expansions in Taylor's series, the Runge-Kutta and the predictor-corrector methods.

1. Introduction

The theory of stellar structure and evolution yields a test on physics of matter in extreme conditions. While tricky numerical models of stellar interiors must be constructed to achieve a precise quantitative agreement of the theory with observation, even rough order-of-magnitude estimates provide a good physical insight of high pedagogic value (cf. Tayler 1970). The aim of the present paper is to give a semi-analytic model of stellar interiors for a didactic purpose. It is based on several physical simplifications – there are used approximate laws for the production of energy (7) and for the opacity (8). Another simplification is the fact that the law for the perfect gas (2) is supposed to be valid for the whole interior of the Sun (which is an important assumption for the numerical solution), even if the numerical results are not the most actual ones. The formulae (2), (7) and (8) are given by Menzel et al. (1963, p. 205).

The method presented here can be used for modelling a general main-sequence star (not necessarily for obtaining the solar model only) and it shows how a system of differential equations can be integrated if it contains a $\frac{0}{0}$ singularity in the point in which are given the limit conditions. The extension of the solutions for the systems (10) and (14), with the continuity, is natural using Taylor's series (22) and (27), because the unknown functions from the systems can be derived.

Taylor's series (22) and (27) are used for obtaining the values for the functions p, t, q, f in a minimum number of integration points from the neighbourhood of the singularity. There were considered only the first terms from the series of powers so as not to introduce high errors. This minimum number of values is dictated by the possibility of using the classical methods of integration given by (23) – (3.) and (28).

For the didactic use it is recommended to consult all the papers given as reference. Menzel et al. (1963) and Schwarzschild (1958) are the fundamental papers for the understanding of the paper which is structured in four sections.

In Chapter 2 there are given the equations of the inner structure for the radiative nucleus and for the convective cover and the transformations which are used in obtaining the systems (10) and (14) which are to be integrated.

In Chapter 3 there are presented the Taylor's series (22) and (25) and with their help there can be eliminated the singularities from the points where are given the limit conditions. It also shows how systems (10) and (14) can be integrated using classical methods.

In Chapter 4 there are presented the numerical results, a short recall of the way how the numerical problems has been solved and the numerical values of the constants which appear in the paper.

2. Presentation of the problem

To give a model of the interior of a star means to determine the variations of physical quantities like the pressure P, temperature T, luminosity L and mass M as functions of the radius r inside the star. Here we consider a model of a star having a radiative nucleus and a convective cover. The following equations of hydrostatic equilibrium, mass distributions, radiative transfer and thermal equilibrium with radiation are valid for the radiative nucleus (see, e.g., Menzel and others, 1963; Aller and McLaughlin, 1965; Cox and Giuli, 1968):

$$\begin{aligned}\frac{dP(r)}{dr} &= -\frac{GM(r)}{r^2}\rho(r);\\ \frac{dM(r)}{dr} &= 4\pi r^2\rho(r),\\ \frac{dL(r)}{dr} &= 4\pi r^2\rho(r)\varepsilon(r);\\ \frac{dT(r)}{dr} &= -\frac{3}{4ac}\frac{\kappa(r)\rho(r)}{T^3(r)}\frac{L(r)}{4\pi r^2},\end{aligned} \tag{1}$$

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$\rho(r)$ is the density at the r distance from the centre, $\varepsilon(\rho(r), T(r), X, Y)$ is the energy generation per gram per second, $\kappa(\rho(r), T(r), X, Y)$ is the opacity per unit of mass, and X, Y are the proportions of hydrogen and helium.

We neglect the radiation pressure and assume that the equation of state

$$P(r) = \frac{1}{\mu}\frac{k}{H}\rho(r)T(r) \tag{2}$$

of the perfect gas is valid for the whole interior. System (1) has the following limit conditions in the centre of the star:

$$\begin{aligned} M(0) &= 0; \\ L(0) &= 0; \\ P(0) &= P_c = ?; \\ T(0) &= T_c = ? \; at \; r = 0. \end{aligned} \tag{3}$$

The hydrostatic equilibrium equation as well as the mass distribution and the adiabatic equations (Menzel and others, 1963):

$$\begin{aligned} \frac{dP(r)}{dr} &= -\frac{GM(r)}{r^2}\rho(r); \\ \frac{dM(r)}{dr} &= 4\pi r^2 \rho(r); \\ P(r) &= K\rho^{\frac{5}{3}}(r) \quad or \quad P(r) = K_1 T^{2.5}(r) \end{aligned} \tag{4}$$

are valid for the whole convective zone.

System (4) has the following limit conditions at the star surface:

$$\begin{aligned} M &= M_0; \\ L &= L_0; \\ T &= 0; \quad P = 0 \quad at \quad r = R_0. \end{aligned} \tag{5}$$

Schwarzschild's transformations are applied to the system (1) and (4) (Schwarzschild, 1958):

$$\begin{aligned} P(r) &= p\frac{GM^2}{4\pi R^4}; \\ T(r) &= t\frac{\mu H}{k}\frac{GM}{R}; \\ M(r) &= qM; \\ L(r) &= fL \quad and \quad r = R{\cdot}x, \end{aligned} \tag{6}$$

where from now on p, t, q, x, f are dimensionless variables.

For the production of energy we consider the following formula:

$$\varepsilon = \varepsilon_0 \rho(r) T^{4.5}(r), \; where \; \varepsilon_0 = 2.8 \cdot 10^{-33} X^2 \tag{7}$$

and for opacity:

$$\kappa = \kappa_0 \rho^{0.75}(r) T^{-3.5}(r);$$

$$\kappa_0 = 6.52 \cdot 10^{24}(Z + \frac{X+Y}{59.3})(1+X)^{0.75}. \tag{8}$$

Using Schwarzschild's transformations and laws (7) and (8) in system (1) and (4), they will become:

$$\begin{aligned} \frac{dp}{dx} &= -\frac{pq}{tx^2}; \\ \frac{dq}{dx} &= \frac{px^2}{t}; \\ \frac{df}{dx} &= Dp^2x^2t^{2.5}; \\ \frac{dt}{dx} &= -C\frac{p^{1.75}f}{x^2t^{8.25}} \end{aligned} \tag{9}$$

respectively:

$$\begin{aligned} \frac{dp}{dx} &= -\frac{pq}{tx^2}; \\ \frac{dq}{dx} &= \frac{px^2}{t} \quad and \quad p = Et^{2.5}, \end{aligned} \tag{10}$$

where:

$$\begin{aligned} E &= 4\pi K_1 \left(\frac{H}{k}\right)^{2.5} G^{1.5}M^{0.5}R^{1.5}\mu^{2.5}; \\ C &= \frac{3\kappa_0}{4ac}\frac{1}{(4\pi)^{2.75}}\left(\frac{k}{HG}\right)^{7.5}\frac{LR^{1.25}}{M^{5.75}\mu^{7.5}}; \\ D &= \frac{\varepsilon_0}{4}\left(\frac{GH}{k}\right)^{4.5}\frac{M^{6.5}}{LR^{7.5}}\mu^{4.5}. \end{aligned} \tag{11}$$

The limit conditions become as follows:

$$at \; the \; centre: x = 0; f = 0; q = 0; t = ?; p = ? \tag{12}$$

$$and \; at \; the \; surface: x = 1; f = 1; q = 1; t = 0; p = 0.$$

If we start the integration of system (9), we obtain a double infinity of solutions for the nucleus, due to the possibility of choosing the values of pressure and temperature in the center. We perform another variable transformation, which will remove an infinity of solutions for the radiative nucleus.

We consider:

$$\begin{aligned} x &= x_0 x^* \quad and \quad t = t_0 t^*; \\ f &= f_0 f^*; \\ p &= p_0 p^* \quad and \quad q = q_0 q^*, \end{aligned} \tag{13}$$

where x_0, t_0, f_0, p_0, q_0 are interminate constants. We impose the following form to system (9):

$$\begin{aligned} \frac{dp^*}{dx^*} &= -\frac{p^*q^*}{t^*{x^*}^2}; \\ \frac{dq^*}{dx^*} &= \frac{p^*{x^*}^2}{t^*}; \\ \frac{df^*}{dx^*} &= {p^*}^2{x^*}^2{t^*}^{2.5}; \\ \frac{dt^*}{dx^*} &= -\frac{{p^*}^{1.75}f^*}{{t^*}^{8.25}{x^*}^2} \end{aligned} \tag{14}$$

and thus x_0, t_0, p_0, f_0, q_0, C, D verify system (15):

$$\begin{aligned} \frac{q_0}{t_0 x_0} &= 1 \quad and \quad \frac{p_0 x_0^3}{t_0 q_0} = 1; \\ C\frac{p_0^{1.75} f_0}{t_0^{9.25} x_0} &= 1; \\ D\frac{p_0^2 t_0^{2.5} x_0^3}{f_0} &= 1. \end{aligned} \tag{15}$$

If we consider an already known chemical composition, we may calculate the value of C and D, but besides them system (15) contains five unknown quantities, so one of them may be chosen. We have chosen $t_0 = t_c$, so $t_c^* = 1$.

Both system (10) and system (14) present singularities in the points where the limit conditions are given. A difficult problem, the one of connecting the solutions should be elucidated. We have to ensure the continuity of the parameters $P(r)$, $T(r)$, $M(r)$ and $L(r)$. Three new parameters are introduced by the relations:

$$\begin{aligned} U &= \frac{d\log M(r)}{d\log r}; \\ V &= -\frac{d\log P(r)}{d\log r}; \\ (n+1) &= \frac{d\log P(r)}{d\log T(r)}. \end{aligned} \tag{16}$$

We perform the calculations in (16) and obtain:

$$\begin{aligned} U &= 4\pi r^3 \frac{\rho(r)}{M(r)} = \frac{p x^3}{qt} = \frac{p^* x^{*3}}{q^* t^*}; \\ V &= \frac{\rho(r)}{P(r)}\frac{GM(r)}{r} = \frac{q}{tx} = \frac{q^*}{t^* x^*}; \end{aligned} \tag{17}$$

and $(n+1)$ form corresponding to the radiative nucleus will become:

$$(n+1)_{rad} = \frac{16\pi ac}{3}\frac{GM(r)T^4(r)}{P(r)\kappa(r)L(r)} =$$

$$= \frac{1}{C}\frac{qt^{8.25}}{fp^{1,75}} = \frac{q^* t^{*8.25}}{f^* p^{*1.75}}. \tag{18}$$

We calculate $(n+1)$ corresponding to the convective zone and we obtain:

$$(n+1)_{conv} = 2.5. \tag{19}$$

Pressure and temperature being continuous functions, $(n+1)$ should be a continuous function. The convective zone begins in the point x^* where $(n+1) = 2.5$. Starting with a certain value for p_c^*, within the plane (U, V) we obtain a corresponding curve having a final corresponding value (U_i, V_i) where the radiative zone ceases to exist. Starting with a certain E we can integrate system (10) and set out plot a corresponding curve in the plane (U, V). But the continuity of the functions corresponding to mass and pressure asks a continuous curve in the plane (U,V). Thus, if we choose a certain E, then we may choose a value for pc* so that continuity within the plane (U, V) should be obtained, but we may consider the problem the other way as well, that is to start by choosing p_c^* and then to interpolate as against E.

We suppose that a connection of a certain E and of a p_c^* has been achieved, then we determine the constants x_0, p_0, f_0, q_0, t_0, C and D. The assumption that a connection has been achieved gives us the value of the parameters q, p, f, t at the interference both from surface and from centre, thus we know: x_{is}, q_{is}, t_{is}, p_{is} and x_{ic}, p_{ic}, t_{ic}, f_{ic}, q_{ic} and, as there is no energy produced within the convective zone; it follows $f_{is} = 1$, where *is* shows that there is a value at the inference considered from surface, and *ic* shows that there is a value of a parameter, considered from centre. Using (13), we have:

$$\begin{aligned} x_{is} &= x_0 x_{ic}^* \quad and \quad p_{is} = p_0 p_{ic}^*; \\ f_{is} &= 1 = f_0 f_{ic}^*; \\ q_{is} &= q_0 q_{ic}^* \quad and \quad t_{is} = t_0 t_{ic}^*, \end{aligned} \tag{20}$$

which give us the values x_0, f_0, t_0, q_0. System (15) gives us the values of C and D. We suppose that variables for a certain E and p_c^* for which a connection of the solutions has been achieved. Using the formulae for C and D given by (11), where M, R and L are the mass, radius and luminosity corresponding to the Sun at the present moment, are considered as known data and testing with different chemical compositions we try to obtain values for C and D, equal to those resulting from the calculation. Thus, once the calculus achieved, that is a chemical composition which has been determined, it should be reconsidered until there is obtained a chemical composition as close as possible to the one determined in spectroscopy.

The formulae (1) – (20) are given by Menzel et al. (1963).

3. Tthe problem solved numerically

System (14) has the following limit conditions:

$$x^* = 0; f^* = 0; q^* = 0; t^* = 1 \; and \; p^* \; chosen. \tag{21}$$

This system has a singularity in $x^* = 0$, but system (14) admits solutions in analytic form for each and every neighbourhood of this singularity point. These analytic solutions are prolonged by continuity in the point $x^* = 0$ as well. We note $p_c^* = p_0$, considering the $\Sigma a_n x^n$ solutions and imposing the condition that these series should verify (14), we obtain:

$$p(x) = p_0 - \frac{1}{6}p_0^2 x^2 + \frac{1}{45}(p_0^3 - p_0^{5.75})x^4 +$$

$$+0x^5 + A_6 x^6 + ...;$$

$$q(x) = \frac{1}{3}p_0x^3 + \frac{1}{30}(p_0^{4.75} - p_0^2)x^5 + 0x^6 + B_7x^7 + ...; \quad (22)$$

$$f(x) = \frac{1}{3}p_0^2x^3 - (\frac{1}{15}p_0^3 + \frac{1}{12}p_0^{5.75})x^5 +$$

$$+0x^6 + C_7x^7 + ...;$$

$$t(x) = 1 - \frac{1}{6}p_0^{3.75}x^2 + (\frac{59}{1440}p_0^{4.75} - \frac{3}{32}p_0^{7.5})x^4 +$$

$$+0x^5 + D_6x^6 + ...$$

The series (22) will help us in calculating the values of the solutions in four points contiguous to the origin and to the integration pass $h = 0.01$. In order to obtain the value of the solutions in the following points, we use Adams-Bashforth's extrapolation formula of the forth order (Mozynsky, 1973):

$$V_{k+1} = V_k + h \times$$

$$\times \left(\frac{55}{24}f_k - \frac{59}{24}f_{k-1} + \frac{37}{24}f_{k-2} - \frac{9}{24}f_{k-3} \right), \quad (23)$$

which allows us to calculate the solution in a certain point, if we know the values in four previous points.

Adams-Moulton's interpolation formula

$$V_{k+1} = V_k + h\,(b_{-1}f_{k+1} + ... + b_3f_{k-3}) \quad (24)$$

contains the solution V_{k+1} within the right member in the item f_{k+1}. Out of (23) we obtain a $V_{k+1}^{(0)}$ which replaced in (24) gives the possibility of obtaining a $V_{k+1}^{(1)}$. We apply the successive approximations method and we obtain:

$$V_{k+1}^{(n+1)} = V_k + \frac{251}{720}hf(x_{k+1}, V_{k+1}^{(n)}) +$$

$$+\frac{h}{720}(646f_k - 264f_{k-1} +$$

$$+106f_{k-2} - 19f_{k-3}).$$

The process of approximation continues until $|V_{k+1}^{(n+1)} - V_{k+1}^{(n)}| < 10^{-11}$. System (10) will be integrated under the following condition: for $x = 1$, $p = t = 0$, $q = 1$, E chosen. We perform the variable changing $y = 1-x$, we note the variable by x as well, and thus system (10) becomes as follows:

$$\begin{aligned} \frac{dp}{dx} &= \frac{pq}{t(1-x)^2}; \\ \frac{dq}{dx} &= -\frac{p(1-x)^2}{t}; \\ \frac{dt}{dx} &= \frac{1}{2.5E}\frac{pq}{t^{2.5}(1-x)^2} \end{aligned} \quad (25)$$

it has a singularity in the point $x = 0$ because of t and p.

For the system (25) we propose Taylor's series:

$$\begin{aligned} p(x) &= a_1x + a_2x^2 + a_3x^3 + ..., \\ q(x) &= 1 + b_1x + b_2x^2 + b_3x^3 + ..., \\ t(x) &= c_1x + c_2x^2 + c_3x^3 + ... \end{aligned} \quad (26)$$

Returning to the old variable in the neighbourhood of $x = 1$, we have for the system (10):

$$\begin{aligned} p(x) &= \frac{E}{2.5^{2.5}}(1-x)^{2.5} + ...; \\ q(x) &= 1 - \frac{E}{2.5^{2.5}}(1-x)^{2.5} + ...; \\ t(x) &= \frac{1}{2.5}(1-x) + \frac{14E}{4+25E}(1-x)^2 + ... \end{aligned} \quad (27)$$

We use (27) in calculating the value of the solutions in one single point contiguous to 1. In order to calculate the values of the solutions in the following three points, we use Runge-Kutta's method for non-autonomous systems:

$$\begin{aligned} V_{k+1} &= V_k + h\left(\frac{1}{6}l_1 + \frac{1}{3}l_2 + \frac{1}{3}l_3 + \frac{1}{6}l_4\right); \\ l_1 &= f(x_k, V_k); \\ l_2 &= f(x_k + \frac{h}{2}, V_k + \frac{h}{2}l_1); \\ l_3 &= f(x_k + \frac{h}{2}, V_k + \frac{h}{2}l_2); \\ l_4 &= f(x_k + h, V_k + hl_3); \\ h &= x_{k+1} - x_k = 10^{-3}. \end{aligned} \quad (28)$$

Thus, we obtain the values of the solutions in four points, which allows us to continue with the predictor-corrector method. The formulae (23)-(3.) and (28) are in Moszynski (1973).

4. Results and conclusions

As we have already stated in the first chapter, we choose a p_c^* and perform the interpolation considering different values of E until we obtain a connection within the plane (U, V), and within the help of the values C and D resulted from the calculus, we determine a chemical composition. The whole calculus is reconsider by choosing another p_c^* and obtaining a new model until the corresponding chemical composition is as close as possible to the one obtained spectroscopically. The obtained results are presented in Table 1.

In this table the pressure (P) is expressed in units of $10^{18}\frac{dyne}{cm^2}$, the temperature (T) in units of 10^6K, the density ρ in $\frac{gr}{cm^3}$, q is the reduced mass and f is the reduced luminosity.

We consider the best connection the one to which the chemical composition is corresponding: $X = 0.709, Y = 0.27, Z = 0.021$, because it is the closest to the chemical composition spectroscopically determined: $X = 0.708$,

Table 1: The obtained results

x	P	q	f	T	ρ
0.000	0.1768	0.000	0.000	14.0935	93.2879
0.0058	0.1766	0.1294E-4	0.1270E-3	14.0879	93.2188
0.0231	0.1736	0.8226E-3	0.7895E-2	14.0052	92.1882
0.0405	0.1673	0.4344E-2	0.0397	13.8262	89.9569
0.0811	0.1417	0.0325	0.2423	13.0763	80.6036
0.1043	0.1229	0.0654	0.4132	12.4815	73.2086
0.1507	0.0836	0.1693	0.7291	11.0821	56.1290
0.2029	0.0472	0.3293	0.9205	9.4229	37.2793
0.2551	0.0238	0.4990	0.9823	7.8895	22.4779
0.3015	0.0122	0.6332	0.9959	6.7044	13.5391
0.3537	0.5523E-2	0.7530	0.9993	5.5780	7.3617
0.4059	0.2447E-2	0.8368	0.9998	4.6468	3.9153
0.4523	0.1177E-2	0.8937	0.9999	3.9564	2.2130
0.5045	0.5147E-3	0.9348	0.9999	3.3057	1.1576
0.5509	0.2453E-3	0.9589	0.9999	2.8183	0.6470
0.6031	0.1054E-3	0.9763	0.9999	2.3522	0.3331
0.6553	0.4440E-4	0.9868	0.9999	1.9562	0.1687
0.7017	0.2005E-4	0.9925	0.9999	1.6518	0.0902
0.7539	0.7847E-5	0.9963	0.9999	1.3529	0.0431
0.8003	0.3218E-5	0.9981	0.9999	1.1186	0.0213
0.8525	0.1071E-5	0.9992	0.9999	0.8790	0.0090
0.8931	0.4034E-6	0.9996	0.9999	0.6786	0.0044
0.8970	0.3639E-6	0.9997	0.9999	0.6531	0.0041

$Y = 0.272$, $Z = 0.02$. For $p_c^* = 0.6805133181695$ we obtain:
$E = 0.89$, $X = 0.709$, $Y = 0.272$, $Z = 0.021$, $x_i = 0.897$, $q_i = 0.9997$, $T_i = 0.653 \cdot 10^6 K$, $\rho_i = 0.0041 \frac{gm}{cm^3}$, $P_c = 0.17686 \cdot 10^{18} \frac{dyne}{cm^2}$, $T_c = 14 \cdot 10^6 K$, $\rho_c = 93.3 \frac{gm}{cm^3}$.

For the sake of comparison, we want to mention what Schwarzschild obtained: $E = 0.86$, $X = 0.7$, $Y = 0.276$, $Z = 0.024$, $x_i = 0.891$, $q_i = 0.998$, $T_i = 0.7 \cdot 10^6 K$, $\rho_i = 0.0058 \frac{gm}{cm^3}$, $T_c = 13.8 \cdot 10^6 K$, $\rho_c = 88 \frac{gm}{cm^3}$.

x_i, q_i, T_i represent the reduced radius, the reduced mass and the temperature at the surface of the radiative nucleus and T_c and ρ_c represent the values of the temperature and density in the centre of the star.

A Numerical solution at limit conditions

In the solution of the system of differential equations (14) with the limit conditions (21) in the centre of the star, there appear indeterminations of the type $\frac{0}{0}$. We can overcome this problem using the Taylor's series of the form $\Sigma a_n x^n$:

$$\begin{aligned} p(x) &= p_0 + A_1 x + A_2 x^2 + A_3 x^3 + \dots ; \\ q(x) &= B_1 x + B_2 x^2 + B_3 x^3 + \dots ; \\ f(x) &= C_1 x + C_2 x^2 + C_3 x^3 + \dots ; \\ t(x) &= 1 + D_1 x + D_2 x^2 + D_3 x^3 + \dots , \end{aligned} \tag{29}$$

where $p_0 = p_c^*$, and we use x instead of x^* for the sake of simplicity in writing for the system (22). We have assumed that the pressure $p(x)$, the temperature $t(x)$, the luminosity $f(x)$ and the mass $q(x)$ are continuous functions and using the series (29) in (14) we have obtained their expressions given by (22). We thus see how the classical methods of numeric integration can be used to solve such a system (the formulae 23-3.) by the successive approximations until $|V_{k+1}^{(n+1)} - V_{k+1}^{(n)}| < 10^{-11}$.

Schwarzschild (1958) used the logarithmic variables for the system (14) transforming the indeterminations of the form of $\frac{0}{0}$ into other indeterminations of the form of $\frac{\infty}{\infty}$, and Sears (1964) used the mass $m = \frac{M(r)}{M}$ as independent variable.

When the limit conditions:

$$\begin{aligned} x &= 1; \\ f &= 1; \\ q &= 1; \\ t &= 0; \\ p &= 0 \end{aligned} \tag{30}$$

at the surface of the star are used in the system (10), what corresponds to the convective cover, there appears the indetermination of the form of $\frac{0}{0}$ as well. Using the series of powers, we have obtained for the convective cover the expressions (27) and the formula (28) can be used to continue the integration of system (10). In conclusion this way of mathematical and numerical approach permits obtaining any homogeneous stellar model which has a radiative nucleus and a convective cover.

B The values of the constants whuch appea in the paper

$$\begin{aligned} G &= 6.672 \cdot 10^{-8} \, \frac{cm^3}{gs}; \\ R &= 6.96 \cdot 10^{10} \, cm; \\ H &= 1.6725 \cdot 10^{-24} \, g; \\ M &= 1.9891 \cdot 10^{33} \, g; \\ k &= 1.3805 \cdot 10^{-16} \, \frac{erg}{K}; \\ \mu &= \frac{4}{3 + 5X - Z}; \\ a &= 7.564 \, \frac{erg}{cm^2 deg^4}; \\ c &= 299792458 \, \frac{cm}{s}; \\ L &= 3.12 \cdot 10^{33} \, \frac{erg}{s}. \end{aligned}$$

References

[1] L.H. Aller and D.B. McLaughlin AUGHLIN. "Stellar structure," University of Chicago, 1965.

[2] G.R. Burbridge and E.M.Burbridge. "Handbuch der Physik," 5, 251, 1958.

[3] J. Christensen-Dalsgard, G. Berthumieu. "Solar Interior and Atmosphere," The University of Arizona Press, 1992.

[4] J.P. Cox and R.T. Giuli. "Principles of Stellar Structure." Gordon and Breach, New York, 1968.

[5] T. Kirsten and the Gallex collaboration, "Inside the Sun," Kluwer Academic Publishers, 1990.

[6] R.L Kurucz. "Stellar Atmospheres: Beyond Classical Models," 1991.

[7] C.B. Hasefgrove and F. Hoyle. MNRAS, 119, 112, 1959.

[8] D.H. Menzel, P.L. Bhatnagar, H.K. Sen. "Stellar Interiors," vol. VI, Chapman and Hall Ltd. London, 1963.

[9] K. Moszynski. "Numerical Methods of Solving the Ordinary Differential Equations," Technic Press, Bucharest, 1973.

[10] M. Schwarzschild. "Structure and Evolution of the Stars," Princeton University Press, 1958.

[11] R.L. Sears. Ap. J. 140, 477, 1964.

[12] E. Tatomir. Thesis, University of Cluj-Napoca, 1986.

[13] R.J. Tayler. "The Stars: Their Structure and Evolution," Wykeham Publications, London, 1970.

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ABOUT NON-INERTIAL FRAMES

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It is demonstrated that proceeding from the principle of independence of light velocity from acceleration of source emitted it we have to connect the description of accelerated frames with a new mathematical structure: namely with 1-chain bundle (fibration) $\tilde{A}_{3,1}$ built over the space-time continuum $A_{3,1}$.

1) In the Poincare article [1] (see also [2]) the problem of relativistic accelerated motion of particle was considered. In the case of two-dimensional space-time $A_{1,1}$ the equation of such a motion (a is a constant force or relativistic acceleration) is written in the form

$$\frac{d}{dT}\frac{v}{\sqrt{1-v^2/c^2}}=a,$$

where $v=\frac{dX}{dT}$ (X,T are coordinates on $A_{1,1}$). Solution of this equation is (initial velocity is $v_0=0$)

$$X=x+\frac{c^2}{a}\left(\sqrt{1+\left(\frac{aT}{c}\right)^2}-1\right). \tag{1}$$

It follows from here that

$$v=\frac{aT}{\sqrt{1+\left(\frac{aT}{c}\right)^2}}, \tag{2}$$

and hence we have always $v\le c$. Hereby energy of particle $E=\frac{mc^2}{\sqrt{1-v^2/c^2}}$ is

$$E=mc^2\sqrt{1+\left(\frac{aT}{c}\right)^2},$$

and its momentum $p=\frac{mv}{\sqrt{1-v^2/c^2}}$ is

$$p=maT,$$

so that we have

$$E^2-p^2c^2=m^2c^4.$$

If $aT<<c$ the formula (1) transits into the well known non-relativistic Galilean one.

2) The expression (1) gives the formulas for coordinate transformation at transition from inertial frames (coordinates X,T) to the accelerated ones (coordinates x,t). At the condition $T=t$, we come to the formulas

$$X=x+\frac{c^2}{a}\left(\sqrt{1+\left(\frac{at}{c}\right)^2}-1\right),\ T=t, \tag{3}$$

or in differential form

$$dX=dx+\frac{atdt}{\sqrt{1+\left(\frac{at}{c}\right)^2}},\quad dT=dt,$$

hereby Lorentzian interval

$$ds^2=c^2dT^2-dX^2$$

(metric on $A_{1,1}$) is written in the form

$$ds^2=c^2\frac{dt^2}{1+\left(\frac{at}{c}\right)^2}-\frac{2atdtdx}{\sqrt{1+\left(\frac{at}{c}\right)^2}}-dx^2 \tag{4}$$

(see also [2]). In the case when t is the proper time (in this case in (4) $dx=0$), it follows from equation for proper time

$$dt=dT/\sqrt{1+(aT/c)^2}$$

that $T=\frac{c}{a}sh\frac{at}{c}$ (see [2]). Hereby interval

$$ds^2=c^2dT^2-dX^2$$

is written in the form

$$ds^2=c^2dt^2-2c\ sh\frac{at}{c}dtdx-dx^2 \tag{5}$$

(further only case of $T=t$ is considered; in brackets we give formulas for metric (6)). Further we want to continue the consideration of this problem.

3) In the case of photon we have $ds^2=0$ and from (4) it is getting the following equation for light velocity $V=\frac{dx}{dt}$ in accelerated frame:

$$V^2+\frac{2atV}{\sqrt{1+\left(\frac{at}{c}\right)^2}}-\frac{c^2}{1+\left(\frac{at}{c}\right)^2}=0$$

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($V^2-2csh\frac{at}{c}V-c^2=0$). We recall that in an inertial frame light velocity is equal $\frac{dX}{dT}=c$. But now we have

$$V=\pm c-\frac{at}{\sqrt{1+\left(\frac{at}{c}\right)^2}}=\pm c-v \qquad (6)$$

($V=\pm ce^{\mp at/c}$). V, defined by the formula (8), is called sometimes coordinate velocity of light or non-measurable, non-physical one, see [2]. It is getting that at $t\to\infty$ light velocity V may be equaled to 0 or $-2c$ (hereby in the frame with proper time V will be 0 or even $-\infty$). Note, that formula $V=c-v$ (8) looks like Galilean formula for velocity transformation and therefore does not satisfy to *the principle of constancy of light velocity* (concerning the Poincare-Einstein relativity principle, it is broken by consideration of accelerated motion). However the experiment (of the Michelson-Morley type) shows that light velocity does not depend on velocity of source and its acceleration too. It follows from here the statement: coordinate net x,t does not fitted for description of accelerated motion. More over the space with metric (4) is not the space in which light (and others material objects for which $ds^2\neq 0$) are spreading (the matter is that magnitude dx is not distance). But if metric (4) being writing in new variables χ,τ introduced by means of formulas (full square is made in (4))

$$d\tau=\frac{dt}{\sqrt{1+\left(\frac{at}{c}\right)^2}}-\frac{atdx}{c^2},\ d\chi=\sqrt{1+\left(\frac{at}{c}\right)^2}dx \qquad (7)$$

($d\tau=dt-\frac{1}{c}sh\frac{at}{c}dx,\quad d\chi=ch\frac{at}{c}dx$) is written in the form

$$ds^2=c^2d\tau^2-d\chi^2,$$

where light velocity defined as $d\chi/d\tau$ (at the condition $ds^2=0$) is equal c:

$$d\chi/d\tau=c.$$

Therefore the variables χ,τ are more fitted for description of accelerated motions than x,t, as they are in accordance with the principle of light velocity constancy (in comparison with dx magnitude $d\chi$ is a distance). Proceeding from this we say that light is spreading in "the space with coordinates χ,τ", but not with coordinates x,t. The words the space with coordinates χ,τ are inverted commas because this object is indeed not space at all. We deal here with another mathematical structure.

4) As well known to be χ,τ coordinates of any space (manifold) their differentials must be exact differential forms. But they are not a such. In fact if the formulas (10) to write in the form of

$$d\tau=Adt+Bdx,\ d\chi=Cdt+Ddx,$$

where coefficients

$$A=1/\sqrt{1+\left(\frac{at}{c}\right)^2},\ B=-at/c^2$$

and

$$C=0,\ D=\sqrt{1+\left(\frac{at}{c}\right)^2},$$

so the conditions

$$\frac{\partial A}{\partial x}=\frac{\partial B}{\partial t},\ \frac{\partial C}{\partial x}=\frac{\partial D}{\partial t}$$

must be satisfied in order $d\chi$, $d\tau$ to be exact differential forms. However these conditions are not satisfied. Hereby χ,τ themselves are written in the form of integrals

$$\tau=\int_\Gamma^{(x,t)}d\tau,\quad \chi=\int_\Gamma^{(x,t)}d\chi, \qquad (8)$$

which depend on not only point (x,t), but contour Γ, outgoing from point $(0,0)\in A_{3,1}$ and incoming in point $(x,t)\in A_{3,1}$. Further applying the Stokes theorem it may be written

$$\oint_\Omega(Adt+Bdx)=\int_S\left(\frac{\partial A}{\partial x}-\frac{\partial B}{\partial t}\right)dxdt,$$

$$\oint_\Omega(Cdt+Ddx)=\int_S\left(\frac{\partial C}{\partial x}-\frac{\partial D}{\partial t}\right)dxdt,$$

where S is a surface limited by closed contour Ω. When S is a rectangle these integrals are equal correspondingly

$$\frac{a}{c^2}xt \qquad \left(\frac{x}{c}\mathrm{sh}\,(at/c)\right)$$

and

$$x\left(\sqrt{1+(at/c)^2}-1\right) \qquad (x\,(\mathrm{ch}\,(at/c)-1)).$$

5) In connection with this usually one concludes that clock synchronize is impossible in variables χ,τ (see, for example, [2]). It is a pure mathematical fact. However there is a question: what is the reason of this phenomenon? To answer this question we have to recall the notion of admitted coordinate systems. Here is the exact definition.

Transition from the coordinate system X_μ (for example from Galilean system given by coordinates X_μ) to any another one given by arbitrary coordinates x_μ, described by functions $f_\mu:\ X_\mu=f_\mu(x_\nu)$, is admitted, if:

i) the Riemann-Christoffel tensor $R_{\mu\nu\rho\sigma}$ is not change at such transformations;

ii) f_μ are continuous one-to-one valued functions, so that the topology of the manifold does not change. Hereby the metric equaled in the Galilean system to $\delta_{\mu\nu}$, makes

$$g_{\mu\nu}(x) = \frac{\partial f_\rho}{\partial x_\mu}\frac{\partial f_\rho}{\partial x_\nu},$$

and we demand else (in order to not go out of the framework of manifolds);

iii) a new metric $g_{\mu\nu}(x)$ must satisfy the conditions of integralibity:

$$\frac{\partial\sqrt{g_{00}}}{\partial x_i} = \frac{\partial}{\partial x_0}\frac{g_{0i}}{\sqrt{g_{00}}}, \quad \frac{\partial}{\partial x_i}\frac{g_{ok}}{\sqrt{g_{00}}} = \frac{\partial}{\partial x_k}\frac{g_{oi}}{\sqrt{g_{00}}}$$

(see for example [2]). The latter condition leads to the following relations between the functions f_μ:

$$\frac{\partial^2 f_\rho}{\partial x_i \partial x_0}\frac{\partial f_\nu}{\partial x_0}\left(\frac{\partial f_\nu}{\partial x_0}\frac{\partial f_\rho}{\partial x_k} - \frac{\partial f_\rho}{\partial x_0}\frac{\partial f_\nu}{\partial x_k}\right) = = \frac{\partial^2 f_\rho}{\partial x_k \partial x_0}\frac{\partial f_\nu}{\partial x_0}\left(\frac{\partial f_\nu}{\partial x_0}\frac{\partial f_\rho}{\partial x_i} - \frac{\partial f_\rho}{\partial x_0}\frac{\partial f_\nu}{\partial x_i}\right).$$

In particular (if $k = 0$):

$$\frac{\partial^2 f_\rho}{\partial^2 x_0}\frac{\partial f_\nu}{\partial x_0}\left(\frac{\partial f_\nu}{\partial x_0}\frac{\partial f_\rho}{\partial x_i} - \frac{\partial f_\rho}{\partial x_0}\frac{\partial f_\nu}{\partial x_i}\right) = 0.$$

In general geometry conditions i)-iii) definite so called general relativity principle.

6) In turns out the transition from inertial frame to non-inertial (accelerated) ones described by functions (3) is not admitted as these functions satisfy the condition i) only. Hereby new variables χ, τ are indeed coordinates on 1-chain fibration $\tilde{A}_{1,1}$ (it is a some kind of covering structure built over $A_{1,1}$), but not on manifold $A_{1,1}$ itself (see further), as they depend on not only point of manifold x, t, but contour Γ else, laying in the manifold and connecting point $(0,0)$ with point (x,t). It is quite another mathematical structure than manifold (space)[1]

In (12) Γ is a trajectory (chain) in $A_{1,1}$, given by equation $\Gamma = x(t)$. If we will consider only analytical chains beginning in zero, so we may write $x(t) = \sum\limits_{n=1}^{\infty} a_n t^n$ (Tailor series). Every such chain is set by infinite system of coordinates $\{a_n\}_{n=1}^{\infty}$. Hence, studying accelerated motion we have to rise over $A_{1,1}$ and to consider 1-chain fibration $\tilde{A}_{1,1}$, but not limiting by itself $A_{1,1}$.

Set of variables $(x,\ t,\ a_1,\ a_2,\ \ldots)$ defines an element (point) of a new structure $\tilde{A}_{1,1} = (A_{1.1}, \Omega)$, where Ω is a set of cycles in $A_{1,1}$, beginning in zero point $(0,0)$ and ending in the same zero point. Ω is a fiber over zero point of base (manifold) $A_{1,1}$. The fiber over arbitrary point (x,t) of manifold $A_{1,1}$ is a set of chains beginning in zero point and ending in the point with coordinates (x,t). This set may be written as $\Omega \circ \Gamma$, where Γ is any chain beginning in $(0,0) \in A_{1,1}$ and ending in (x,t), and $\circ$ is multiplication law of chains, see [4]. As is seen $\tilde{A}_{1,1}$ is covering structure.

As the end (x,t) of chain Γ is determined by the chain itself and we can write that $(x,t) = p(\Gamma)$, where ρ is the projection of fibration $\tilde{A}_{1,1}$ into base $A_{1,1}$, so we may consider that variables on $\tilde{A}_{1,1}$ consist of only chains Γ. Therefore we write $\chi = \chi(\Gamma)$, $\quad \tau = \tau(\Gamma)$. $\tilde{A}_{1,1}$ is a topological space (but of course not manifold). Speciality of variables χ, τ consists in the following: they realize local isomorphism between $\tilde{A}_{1,1}$ and $A_{1,1}$. In fact differentiating formulas (12), we obtain for example

$$d\tau = \frac{dt}{\sqrt{1 + \left(\frac{at}{c}\right)^2}} - \frac{atdx}{c^2} + \frac{\partial\tau}{\partial\Gamma}d\Gamma,$$

where

$$\frac{\partial\tau}{\partial\Gamma}d\Gamma = d\tau_\Gamma = \left(\int\limits_{\Gamma}^{(x,t)} - \int\limits_{\Gamma+\delta\Gamma}^{(x,t)}\right) d\tau = \oint\limits_{\omega} d\tau.$$

Here integral is taken over contour ω named lasso.

Due to the Stokes theorem we may write

$$\oint\limits_{\omega} d\tau = \frac{a}{c^2}\int\limits_{\sigma} dxdt = \frac{a}{c^2}\sigma,$$

where σ is an infinite small area embraced by lasso. It is infinite small magnitude of the second degree in comparison with dx or dt, and therfore we may neglect it. As a result we come to the formulas (10).[2]

So, formally speaking, to combine the notion of inertial frame with the principle of light velocity constancy

[1]Note with appearance of integrals depending on chains a new physics has been always connected. So, the transition from exact phase transformation of wave functions $e^{i\chi}\psi$, where $\chi = \int \frac{\partial\chi}{\partial X_\mu}dX_\mu$ (in the Lorentz theory functions χ describe vibrations of ether, see [3]), to the transformations $e^{i\tilde{\chi}}\psi$, depending on chains where $\tilde{\chi} = \int A_\mu(X)\, dX_\mu$, and $A_\mu(X)$ are some functions on space-time, means the switching on observable electromagnetic fields $A_\mu(X)$. In our case appearance of chain fibration we connect with non-observable media - ether which fills all space (see further).

[2]The problem about relativistic rotation motion may be considered of course by the same mathematical tools. Instead of $A_{1,1}$ the space $A_{2,1}$ will appear only. In more general case we will deal with the Poincare space $A_{3,1}$. It is interesting to note that in the given approach we deal with definite mathematical realization of the idea concerning infinite dimensional space-time when unnecessary dimensions (coordinates) become automatically noneffective in small (locally), cf. with the Kaluza-Klein ansatz [5]).

is possible in the framework of pseudoeuclidean space-time $A_{3,1}$ only. Now we see that to combine the notion of non-inertia frame with principle of light velocity constancy is possible in the framework of covering structure $\tilde{A}_{3,1}$ built over the space-time continuum $A_{3,1}$.

7) Now we would like to come up to the problem from the pure physical point of view (but not from formal mathematical, axiomatic one). As is known in classical and quantum physics the space-time is considered to be continual manifold (continuum). A question is arisen: why have we to consider it, first, as a connected set of points, and secondly, four-dimensional manifold? As every space consists of points (Euclid), i.e. of objects of zero measure, so it is natural and simpler to represent it in the form of a "gas" of points or to be infinite uncountable quite non-connected set of points. In such a case, what is the reason of making it as four-dimensional continuum M_4. It is of course not mathematical but pure physical question, because there is not any mathematical glue in nature. Instead of it the connectedness axiom is excepted (or is not excepted) in mathematics (in essential the Descartes-Newtonian model of space cleaned from the coordinates is excepted).

As is known axiomatic approach to a problem is always connected with any coarseness of reality as at such an approach something is rejected to be non-essential. Therefore we deal in this situation with any *model* of reality (it remarkable that in such a case we may use the formal logic with two alternatives: *yes* or *not*). In our case the coarseness is connected with rejection of glue as a hidden physical substance which determines not only continual property (connectedness) of space-time and its dimensionality *4*, but its metric also (see further). At axiomatic approach the connectedness axiom plays the role of glue[3]. However it may not deputize for glue which converts discontinuum into continuum and which plays exclusively important role at creation of elementary particles and Universe in whole. Be situated on physical point of view we consider, that glue which in no way appears in connectedness axiom (it is the third alternative not pre-established in formal logic) is a new hidden physical substance - pre-matter or ether which fills all space but it is not immediately observable. The substance is the reason of existence of space-time in the form of continuum M_4 with dimension *4* (indeed this fact is connected with the Heisenberg algebra $h_8^{(*)}$, underlain the ether theory, see. [4]) and of its metric.

In the case when we may neglect the ether in kinematics[4] (at small velocities of motion through ether) we may consider the manifold M_4 to be Galilean one $A_3 \otimes A_1$, possessing the symmetry of the Galilean group $Ga\,(3,1)$, including in particular Galilean busts:

$$\vec{X} \to \vec{X}' = \vec{X} + \vec{v}t,\ t \to t' = t\left(\vec{X} \in A_3,\ t \in A_1\right).$$

Invariant of this group is written in the form $ds^2_{Ga} = dt^2$. At large velocities ether begins to display itself in so called Lorentzian contraction of lengths, hereby Galilean structure (as it has been elucidated by Lorentz and Poincare) transforms into the Poincare-Minkovski (pseudo-euclidean) one $A_{3,1}$, the symmetry group of which is the Poincare-group $P_{3,1} = SO\,(3,1)\,\mathrm{x})\,T_{3,1}$, where $SO\,(3,1)$ is the proper Lorentz group and $T_{3,1}$ are translations in $A_{3,1}$. Ether as if renormalizes the metric and it becomes the Poincare-Minkovski one

$$ds^2_{PM} = dt^2 - \frac{1}{c^2}\left(dX_1^2 + dX_2^2 + dX_3^2\right).$$

It may be written by means of formula

$$A_3 \otimes A_1 + Ether = A_{3,1}.$$

At such a phenomenological (pure geometrical) approach to the description of ether the latter is described by the metric equaled $ds^2_E = -\frac{1}{c^2}\left(dX_1^2 + dX_2^2 + dX_3^2\right)$[5] and is a isotropic media. Thus $c$is a one of characteristics of ether with which the existence of light cone is connected. The fact, that the observable metric is only the sum of metrics ds^2_{PM}, but not its separate addendum, is the meaning of the Poincare-Einstein special relativity principle. It speaks that ether itself is not immediately observed entity. We emphasize that $A_3 \otimes A_1$ and $A_{3,1}$ are different formations of one and the same four dimensional continuum M_4[6]. In the both cases relativity principle is connected with corresponding symmetry groups of these spaces.

Further methamorphose of space-time $A_{3,1} \to \tilde{A}_{3,1}$ is connected with reaction of ether on accelerated motion through ether. We consider that namely ether is responsible for appearance of chain fibration of space at considering of accelerated motion. Usually one considers that transition from inertial frame to a non-inertial one may be connected with change of metric of space-time, hereby space stays to be manifold. We saw that

[3] So the matter is outside the particle. However inside the particle space should be considered to be quite non-connected set of points namely Cantor's perfect set (it follows from granule structure of fundamental particles). In [4] it was shown that discontinuum possesses definite dynamical structure, described by the Heisenberg algebra $h_8^{(*)}$.

[4] At the usual conditions observed matter may interact with ether by means of week gravitational manner (like with dark matter), see [4]. Such an interaction does not lead to any observable dynamical effects, in particular, to the observation of the distinguished frame connected with ether. Hereby it has to keep in mind that ether quanta move with light velocity [4] therefore it is impossible to observe the frame connected with ether at all.

[5] Usually one considers that ds^2_{PM} is the metric of "empty" space (without observed matter but with ether). Hereby one considers that at classical level space filling by observed matter is described by Riemannian metric ds^2_R, determined by Friedman's metric tensor $g^F_{\mu\nu}$.

[6] Hereby of course we have to distinguish between Minkovski vector space $R_{3,1}$ (group $SO\,(3,1)$) and affine Poincare one $A_{3,1}$ (group $P_{3,1}$).

such an approach being some approximation only, is not compatible with the principle of constancy light velocity. The transition, following for it, from metric geometry ($R_{\mu\nu\rho\sigma} = 0$) to the Riemannian one ($R_{\mu\nu\rho\sigma} \neq 0$) with the aim to build the theory of gravity based on the so called equivalence principle (geometrical approach to the gravity) is any approximation too.[7]

The existence of the mathematical structures M_4, $A_3 \otimes A_1$, $A_{3,1}$, $\tilde{A}_{3,1}$ well adopted to the phenomenological description of ether makes at first sight the latter to be not needed thing. However in the region of very high energies ether begins to display itself as a dynamical system not Lagrangian or Hamiltonian but bi-Hamiltonian one, see [4].

8) We see that dealing with $\tilde{A}_{3,1}$, first, the point $(0,0)$ must be distinguished: the fiber over this point Ω is group however fiber $\Omega \circ \Gamma$ over any another point (x,t) is not a group. This circumstance does not permit to consider acceleration to be relative (here there is no the Mach principle). Secondly symmetry of structure $\tilde{A}_{3,1}$ is described by the 1-chain group $\tilde{P} = S\tilde{O}\,(3,1)\,\mathrm{x})\tilde{T}_{3,1}$, where $S\tilde{O}\,(3,1)$ is 1-chain group over Lorentzian group $SO\,(3,1)$. Hereby $\tilde{A}_{3,1} = \tilde{P}/S\tilde{O}\,(3,1)$. With this group a new relativity principle is connected.

We well know finite dimensional representations of the group $SO\,(3,1)$ and its subgroup $SO\,(3)$ (and also their coverings $SL\,(2,C)$ and $SU\,(2)$) corresponding to the integer and half-integer spins behind which elementary particles stand - bosons and fermions. However group $S\tilde{O}\,(3,1)$ and $S\tilde{O}\,(3) \approx S\tilde{U}\,(2)$ have non-standard representations corresponding to the arbitrary spins $\lambda \neq 0,\ 1/2,\ 1,\ \ldots$. Non-Fock representations of the Heisenberg algebra $h_8^{(*)}$ are connected with a set of these representations of $S\tilde{O}\,(3,1)$. Behind the representations a new matter forms (distinguished from elementary particles), called pre-matter (or ether) stand, see [4]. Investigation of the structure of representations of the group $S\tilde{U}\,(2)$ gives very much information about this new form of matter.

References

[1] H. Poincare. "About dynamics of electron." In "Principle of relativity." — M.: Atomizdat, 1973, 332 p.

[2] A.A. Logunov. "Lectures on relativity theory and gravity." — M.: Nauka, 1987, 276 p.

[3] E. Whittaker. "History of ether and electricity." M:. MATHESIS, 2001, 512 p.

[4] S.S. Sannikov-Proskuryakov. *Doklady Ac. Of Science USSR*, No. 2, 198, p. 297–300 (1971); *Fizika. Izvestiya Vuzov*, No. 11, p. 52–61 (1999); No. 12, p. 54–59 (2001); *Ukr Journ. of Phys.*, 45, No. 1, p. 9–15, (2000). Spenier E. "Algebraic topology." — M.: Mir, 1971, 680 p.

[5] T. Kaluza. "To the problem of unified physics." In "Albert Einstein and theory of gravity." — M.: Mir, 1979, 592 p.

[7] In the equivalence principle there is no difference between *kinematics* (coordinate transformations) and *dynamics* (interactions) which is different at classical and quantum levels. So at quantum level that are so called radiative corrections which lead to renormalization of charges (see [4]) that has influence on dynamics but not influence on kinematics. In [4] a new gravity theory based on the ether is developed.

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GRAVITY CONTROL THROUGH ELECTRIC AND MAGNETIC FIELDS

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Electron-based plasma and precession frequencies can be related to electric and magnetic field densities, respectively. Localizing the gravitational field density within the Expansive Nondecelerative Universe model and relating it to the electric and magnetic field densities lead to such plasma and precession frequencies that allow partly to control the gravity.

A Introduction

It has been generally hypothesed but still not theoretically proved that common external features of electric, magnetic and gravitational fields (e.g. identical energy vs. distance relationships; general applicability of Yukawa-type potential [1]) are a consequence of their internal common nature. There is a collective efford to definitely unveil this nature and express its physical meaning in the mathematic language. The significance of understanding of this nature is not limited to the theoretical physics. It can offer answers to questions relating to many observed facts (as an example, the temperature of the solar corona can serve [2]) and, moreover, it provides a chance to manipulate with the gravity and exploit thus purposefully this force. The ability of such manipulation has been documented by Podkletnov [3,4], de Aquino [5,6] and their followers.

In this contribution, mutual relations between electric, magnetic and gravitational fields are demonstrated on electron motions. Moreover, a chance to extend such relations to the reign of electromagnetic radiation is suggested.

B Electric field and gravitation

The simplest object, suitable to analyse mutual relations of electric, magnetic, and gravitational fields, are free electrons. Such electrons form main constituent of the plasma state of matter. Plasma can be cosily and reproducibly prepared which permits to experimentally verify formulated theoretical conclusions. This was a key reason of why our attention has been concentrated to plasma.

Electrons present in plasma oscillate with the plasma frequency ν_{pl} defined as [7]

$$\nu_{pl} = \left(\frac{n\, e^2}{4\pi^2 \varepsilon_o m_e}\right)^{1/2}, \tag{1}$$

where n is the concentration (number/volume) of the electrons, m_e and e are the electron mass and charge, respectively, ε_o is the vacuum permittivity. For the electron it is not possible to distinguish the parts of energy relating to its elementary charge and its mass, and thus the electric energy density ε_e can be in a non-relativistic approximation express as

$$\varepsilon_e = n \frac{m_e c^2}{2}. \tag{2}$$

Using (1) and (2) the plasma frequency can be written as

$$\nu_{pl} = \left(\frac{\varepsilon_e\, e^2}{2\pi^2 \varepsilon_o\, m_e^2\, c^2}\right)^{1/2}. \tag{3}$$

The Expansive Nondecelerative Universe model (ENU) [8-10] allows localising the gravitational field energy, the absolute value of its density is given by Tolman equation [10]

$$\varepsilon_g = \frac{R\, c^4}{8\pi\, G} = \frac{3m\, c^2}{4\pi\, a\, r^2}, \tag{4}$$

where ε_g is the gravitational field energy density of a body with the mass m at the distance r, R is the scalar curvature, a is the gauge factor. It was calculated [10] that in case of the Earth,

$$\varepsilon_g = 24.29 \text{ J/m}^3. \tag{5}$$

Creating an electric field with the energy density equal to that of the Earth gravitational energy density

$$\varepsilon_g = \varepsilon_e \tag{6}$$

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the plasma frequency for an electron in such a field is obtained combining (3) and (6)

$$\nu_{pl} = 2.186 \times 10^8 \text{ Hz}. \tag{7}$$

It can be hypothesed that each of the electrons will create the gravitational energy quanta with the output

$$P_g = h\,\nu_{pl}^2. \tag{8}$$

At the Podkletnov's experiments [3,4], the condition (6) was satisfied, since the total charge was

$$Q \cong 0.1\text{C}, \tag{9}$$

which corresponds to a number of the discharged electrons

$$p \approx 10^{18}. \tag{10}$$

The time of discharges varied in a region

$$t_d \cong (10^{-5} - 10^{-4}) \text{ s}. \tag{11}$$

Taking the above values of Q and p, and a mean value of the discharge time into account, the total gravitational energy created within one discharge of used superconducting emitter was

$$E_g = p\,h\,\nu_{pl}^2\,t_d. \tag{12}$$

It follows from (7) to (11) that

$$E_g \approx 10^{-3} \text{ J}, \tag{13}$$

which is in good accordance with the experimental value [4,11].

C Magnetic field and gravitation

The energy of magnetic moment vector precession of an electron placed in the magnetic field with the induction B is [12]

$$\frac{B\,g\,e\,\hbar}{2\,m_e} = \hbar\,\omega, \tag{14}$$

where g is the Lande's factor (2.0023 for a free electron in relativistic approximation), ω is the precession angle frequency.

It holds for the magnetic field energy density ε_m

$$\varepsilon_m = \frac{B^2}{2\mu_o}. \tag{15}$$

Based on (14) and (15) the precession frequency ν_{pr} can be expressed as

$$\nu_{pr} = \left(\frac{e^2\mu_o\,\varepsilon_m}{2\,\pi^2 m_e^2}\right)^{1/2} = \left(\frac{e^2\varepsilon_m}{2\,\pi^2\varepsilon_o\,m_e^2\,c^2}\right)^{1/2}. \tag{16}$$

It is obvious that in case of identical values of the electric field density and magnetic field density, the electron plasma frequency (3) and its precession frequency (16) become equal. In cases when

$$\varepsilon_g = \varepsilon_m \tag{17}$$

it must hold

$$\frac{B_{crit}^2}{2\mu_o} = \frac{3m\,c^2}{4\,\pi\,a\,r^2}. \tag{18}$$

Applying relation (18) to the Earth, we obtain

$$B_{crit(Earth)} \cong 7.7 \times 10^{-3} \text{ T}. \tag{19}$$

Introducing the value given in (5) to (16), the value of the electron precession frequency emerges

$$\nu_{pr} = 2.2 \times 10^8 \text{ Hz}. \tag{20}$$

This value actually corresponds to the known critical induction of magnetic field based on (19).

The total amount of the gravitational energy created by the electrons of the concentration n present in the volume V during the time t_x under the influence of the Earth magnetic field with the critical induction $B_{crit(Earth)}$ will be

$$E_g = n\,h\,\nu_{pr}^2\,t_x\,V. \tag{21}$$

If the plasma is used, an identity of the plasma and precession frequencies is achieved when

$$n \cong 5.5 \times 10^{14} \text{ m}^{-3}. \tag{22}$$

In case of the Sun

$$\varepsilon_{g(Sun)} \cong 626 \text{ J m}^{-3} \tag{23}$$

i.e. the electron plasma frequency equals to its precession frequency provided that the electron concentration is

$$n_{e(Sun)} \approx 10^{16} \text{ m}^{-3}. \tag{24}$$

It happens if

$$B \cong 3.8 \times 10^{-2} \text{ T}. \tag{25}$$

Such values can be achieved in Sun spots and under the above conditions

$$\nu_{pl(Sun)} = \nu_{pr(Sun)} \cong 1.1 \times 10^9 \text{ Hz}. \tag{26}$$

The concentration of electrons being 10^{16} m^{-3} is at the border of chromosphere and corona. Just in this place the gravitational impulses evolve which wobble the particles forming the solar corona increasing thus its temperature to about million Kelvin.

D Electromagnetic radiation and gravitation

Relations (3) and (16) may be applied to any charged "elementary" particles, as well as to electromagnetic radiation.

Introducing

$$m = \frac{h\nu}{c^2} \tag{27}$$

to (3) or (16) we obtain for photons

$$\nu = \left(\frac{\varepsilon_g\, e^2\, c^2}{2\,\pi^2 \varepsilon_o\, h^2} \right)^{1/4} . \tag{28}$$

In the Earth gravitational field, the frequency corresponding to the Earth gravitational energy density (5) is

$$\nu \cong 1.6 \times 10^{14} \ \ \mathrm{Hz}, \tag{29}$$

which is, in a wavelength unit

$$\lambda \cong 1870 \ \mathrm{nm}. \tag{30}$$

This wavelength is part of infrared window of the Earth. The interaction of the Earth gravitation field and electromagnetic radiation might thus contribute to cessation of the intensity of radiation with the given wavelength. It should be pointed out, however, that experimentally such an effect has not been observed. On the other hand, it is worth also noting that commercial infrared spectrometers used in chemistry and physics are very seldom furnished with a source and detectors of this wavelength.

Analogous calculation for the Sun leads to

$$\nu \cong 3.7 \times 10^{14} \ \ \mathrm{Hz}, \tag{31}$$

which corresponds to

$$\lambda \cong 810 \ \mathrm{nm}. \tag{32}$$

The emission visible and IR spectra of the Sun are predominantly of continuous character. It might be, however, a good idea of searching for spectral anomalies about 810 nm.

Acknowledgement

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References

[1] N.A. Zhuck, Spacetime & Substance, 2 (2001) 153.

[2] M. Súkeník, J. Šima, Spacetime & Substance, 3 (2002) 118.

[3] E. Podkletnov, R. Nieminen, Physics, C203 (1992) 441.

[4] E. Podkletnov, G. Modanese, physics/0108005.

[5] F. de Aquino, physics/0205089.

[6] F. de Aquino, J. New Energy, 5 (2000) 67.

[7] F.F. Chen, Plasma Physics and Controlled Fusion, 2nd Ed., Plenum Press, New York, 1984.

[8] V. Skalský, M. Súkeník, Astroph. Space Sci., 178 (1991) 169.

[9] V. Skalský, M. Súkeník, Astroph. Space Sci., 181 (1991) 153.

[10] J. Šima, M. Súkeník, Spacetime & Substance, 2 (2001) 125.

[11] B. Taylor, G. Modanese, physics/0209023

[12] P.W. Atkins, Physical Chemistry, 6th Ed., Oxford University Press, Oxford, 1998.

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THE UNCERTAINTY PRINCIPLE IS UNTENABLE

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By re-analyzing Heisenberg's Gamma-Ray Microscope experiment and the ideal experiment from which the uncertainty principle is derived, it is actually found that the uncertainty principle can not be obtained from them. It is therefore found to be untenable.

A Ideal Experiment 1

1.1. Heisenberg's Gamma-Ray Microscope Experiment

A free electron sits directly beneath the center of the microscope's lens (please see the appropriate page of the American Institute of Physics web site [1] and Fig. 1 below). The circular lens forms a cone of angle 2α from the electron. The electron is then illuminated from the left by gamma rays–high energy light which has the shortest wavelength. These yield the highest resolution, for according to a principle of wave optics, the microscope can resolve (that is, "see" or distinguish) objects to a size of Δx that is related to the given angle 2α and to the wavelength λ of a gamma ray, by the expression:

$$\Delta x = \lambda/(2\sin\alpha) \tag{1}$$

However, in quantum mechanics, where a light wave can act like a particle, a gamma ray striking an electron gives it a kick. At the moment the light is diffracted by the electron into the microscope lens, the electron is thrust to the right. To be observed by the microscope, the gamma ray must be scattered into any angle within the cone of angle 2α. In quantum mechanics, the gamma ray carries momentum as if it were a particle. The total momentum p is related to the wavelength by the formula

$$p = h/\lambda \tag{2}$$

where h is Planck's constant. In the extreme case of diffraction of the gamma ray to the right edge of the lens, the total momentum would be the sum of the electron's momentum p_{1x} in the **X** direction and the gamma ray's momentum in the same direction

$$p_+ = p_{1x} + (h\sin\alpha)/\lambda_{1x}$$

where λ_{1x} is the wavelength of the deflected gamma ray.

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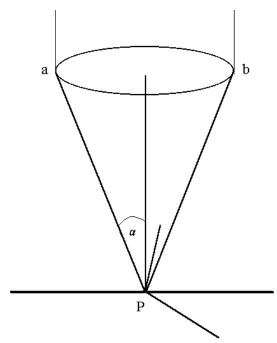

Figure 1: Experiment of Heisenberg Gamma-Ray microscope. Pa and Pb are the extreme forward scattering and extreme backward scattering; 2α is the field angle formed between the diameter of the lens and the object.

In the other extreme, the observed gamma ray recoils backward, just hitting the left edge of the lens. In this case, the total momentum in the X direction is

$$p_- = p_{2x} - (h\sin\alpha)/\lambda_{2x}.$$

The final momentum in each case must equal the initial momentum, since momentum is conserved. Therefore, the final x-projections of the momenta are equal to each other

$$\begin{aligned} &p_{1x} + (h\sin\alpha)/\lambda_{1x} \\ &= p_{2x} - (h\sin\alpha)/\lambda_{2x} \end{aligned} \tag{3}$$

If 2α is small, then the wavelengths are approximately the same,

$$\lambda_{1x} \approx \lambda_{2x}.$$

So we have

$$p_{2x} - p_{1x} = \Delta p_x \approx 2h\sin\alpha/\lambda. \tag{4}$$

Since $\Delta x = \lambda/(2\sin\alpha)$, we obtain a reciprocal relationship between the minimum uncertainty in the measured position, Δx, of the electron along the **X** axis and the uncertainty in its momentum, Δp_x, in the same direction

$$\Delta p_x \sim h/\Delta x, \tag{5a}$$

or

$$\Delta p_x \Delta x \sim h. \tag{5b}$$

For more than minimum uncertainty, the "greater than" sign may added.

Except for the factor of 4π and an equal sign, this is Heisenberg's uncertainty relation for the simultaneous measurement of the position and momentum of an object.

1.2. Re-analysis

To be seen by the microscope, the gamma ray must be scattered into any angle within the cone of angle 2α.

The microscope can resolve (that is, "see" or distinguish) objects to a size of Δx that is related to the angle 2α and to the wavelength λ of the gamma ray, by the expression

$$\Delta x = \lambda/(2\sin\alpha). \tag{6}$$

This is the resolving limit of the microscope and it is the uncertain quantity of the object's position. The microscope can not see the object whose size is smaller than its resolving limit, Δx. Therefore, to be seen by the microscope, the size of the electron must be larger than or equal to the resolving limit.

But if the size of the electron is larger than or equal to the resolving limit, the electron will not be in the range Δx. Therefore, Δx can not be deemed to be the uncertain quantity of the electron's position which can be seen by the microscope, but deemed to be the uncertain quantity of the electron's position which can**not** be seen by the microscope. To repeat, Δx is uncertainty in the electron's position, which can**not** be seen by the microscope.

To be seen by the microscope, the gamma ray must be scattered into any angle within the cone of angle 2α, so we can measure the momentum of the electron.

Δp_x is the uncertainty in the electron's momentum, which can be seen by microscope.

What relates to is the electron where the size is smaller than the resolving limit. When the electron is in the range Δx, it cannot be seen by the microscope, so its position is uncertain.

What relates to Δx is the electron where the size is larger than or equal to the resolving limit. The electron is not in the range Δx, so it can be seen by the microscope and its position is certain.

Therefore, the electron that relates to Δx and Δp_x respectively is not the same. What we can see is the electron where the size is larger than or equal to the resolving limit Δx and has a certain position, $\Delta x = 0$.

Quantum mechanics does not rely on the size of the object, but on Heisenberg's Gamma-Ray Microscope experiment. The use of the microscope must relate to the size of the object. The size of the object which can be seen by the microscope must be larger than or equal to the resolving limit Δx of the microscope, thus the uncertain quantity of the electron's position does not exist. The gamma ray which is diffracted by the electron can be scattered into any angle within the cone of angle 2α where we can measure the momentum of the electron.

What we can see is the electron which has a certain position, $\Delta x = 0$, so that in no other position can we measure the momentum of the electron. In Quantum mechanics, the momentum of the electron can be measured accurately when we measure the momentum of the electron only, therefore, we have gained $\Delta p_x = 0$. Thus,

$$\Delta p_x \Delta x = 0. \tag{7}$$

B Ideal experiment 2

2.1. Single Slit Diffraction Experiment

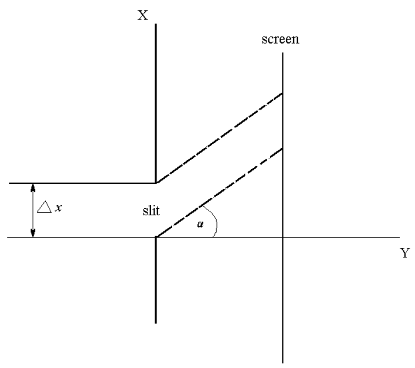

Figure 2: Experiment of single slit diffraction. Δx is the width of the slit; α is the angle where No. 1 min interference pattern is.

Suppose a particle moves in the **Y** direction originally and then passes a slit with width Δx (see Fig. 2 below). The uncertain quantity of the particle's position in the **X** direction is Δx, and interference occurs at the back slit. According to Wave Optics, the angle where No. 1 min of interference pattern is, can be calculated by following formula

$$\sin\alpha = \lambda/2\Delta x \tag{8}$$

and

$$\lambda = h/p$$

where h is Planck's constant. So the uncertainty principle can be obtained

$$\Delta p_x \Delta x \sim h. \tag{9}$$

2.2. Re-analysis

According to Newton's first law, if an external force in the **X** direction does not affect the particle, it will move in a uniform straight line, (Motion State or Static State), and the motion in the **Y** direction is unchanged. Therefore, we can learn its position in the slit from its starting point.

The particle can have a certain position in the slit and the uncertain quantity of the position is $\Delta x = 0$. According to Newton first law, if the external force at the **X** direction does not affect particle, and the original motion in the **Y** direction is not changed, the momentum of the particle int the **X** direction will be $\Delta p_x = 0$ and the uncertain quantity of the momentum will be $\Delta p_x = 0$.

This gives

$$\Delta p_x \Delta x = 0. \tag{10}$$

No experiment negates NEWTON FIRST LAW. Whether in quantum mechanics or classical mechanics, it applies to the microcosmic world and is of the form of the Energy-Momentum conservation laws. If an external force does not affect the particle and it does not remain static or in uniform motion, it has disobeyed the Energy-Momentum conservation laws. Under the above ideal experiment, it is considered that the width of the slit is the uncertain quantity of the particle's position. But there is certainly no reason for us to consider that the particle in the above experiment has an uncertain position, and no reason for us to consider that the slit's width is the uncertain quantity of the particle. Therefore, the uncertainty principle,

$$\Delta p_x \Delta x \sim h \tag{11}$$

that is derived from the above experiment is unreasonable.

C Conclusion

From the above re-analysis, it is realized that the ideal experiment demonstration for the uncertainty principle is untenable. Therefore, the uncertainty principle is untenable.

References

[1] http://www.aip.org/history/heisenberg/p08b.htm

[2] M. Jammer. "The philosophy of quantum mechanics". John Wiley & Sons, Inc., New York (1974), p. 65.

[3] *Ibid.*, p. 67.

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DISTANT MATTER IN PHYSICS

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We report some outstanding features related to the role played by "distant matter" (galaxies) within an updated view of nowadays physics. The recent implementation of Mach's Principle [A.K.T. Assis, Foundations of Physics Letters, **2**, 1989; A.K.T. Assis, "Relational Mechanics," Apeiron. Montreal, 1999; J. Guala-Valverde, Apeiron, **8**, 2001] enhances the relevance of distant matter when dealing with inertial reactions acting on accelerated particles. The recent elucidation of electrodynamic induction [J.Guala-Valverde, Physica Scripta, **66**, 2002; J. Guala Valverde *et al.*, Spacetime & Substance, **3**, 2 (12) 2002; **3**, 3 (13), 2002; J. Guala-Valverde *et al.*. Am.J. Phys, **70**, 2002] points out the irrelevance of distant matter when dealing with electromagnetic phenomena.

A Historical account

The strict proportionality between inertial and gravitational masses (verified with a relative uncertainty below 10^{-11}) intrigued Mach along his life, and compelled him to envisage the idea that distant matter should regulate, inertially, local interactions [1-3]. As it is well known, the above proportionality only appears as a fortuity fact in Classical Mechanics. Moreover, why the best inertial frames employed today are those anchored to distant galaxies? Once, Classical Mechanics is unable to answer the question.

In 1925 E. Schrdinger tried to seek for the origin of inertia by modifying the Newtonian mutual gravitational energy (potential energy) in a suitable manner [4,5]. Guided for heuristic considerations he wrote, for two interacting point gravitational masses M_g, m_g:

$$U = -\left(M_g m_g / r\right)\left[1 - \varepsilon \dot{r}^2 / c^2\right],$$

where $\dot{r} = dr/dt$, c is the velocity of light in a vacuum and ε is a dimensionless parameter that becomes 3 in order to fit the observed planetary precession.

With the aid of is own energy, Schrdinger calculated the energy of interaction for a spherical shell (gravitational mass M_g, radius R) interacting with an internal point mass m_g, moving with the velocity v relative to the shell, in the neighborhood of its center. Thus, he obtains $U = -\left(M_g m_g / R\right)\left[1 - v^2/c^2\right]$. He identified the component of this potential energy, which depends on the velocity with the kinetic energy of the particle. That is, $M_g m_g v^2 / Rc^2 = m_i v^2/2$. Here m_i means inertial mass. It then follows $m_i = \left(2M_g/Rc^2\right) m_g = \left(8\pi\sigma R/c^2\right) m_g$, wherein σ labels the (assumed constant) surface density of gravitational mass.

Later on, Schrdinger integrates the result of the spherical shell for a "world" of radius R_0, supposing a constant mass density. He concludes that taking the radius and the mass density of our own galaxy, then we would obtain a value of G (the gravitational constant) some 10^{11} times smaller than what is really measured. Therefore, the inertia of particles in the solar system must be mainly due to matter farther away from our galaxy.

B Recent account

The pioneer work of Schrdinger was recently improved by Assis [2,3,6] who was able to implement Mach's ideas in a rigorous, entirely general, way. Taking departure with Schrdinger, the startpoint of Assis formulation is a Weber-like law of force which reads, for two point masses 1, 2,

$$F = -H_g\left(m_{g1} m_{g2} / r^2\right)\left[1 - \xi \dot{r}^2 / 2c^2 + \xi r \ddot{r} / c^2\right], \quad (1)$$

where $\ddot{r} \equiv d^2r/dt^2$ and H_g and ξ are constants. ξ becomes 6 in order to fit the observed planetary precession and H_g becomes 1, also dimensionless, when working with any coherent systems of standards such as the cgs and the MKS ones [7-10]. The outstanding mathematical property of equ. (1) is that it is *invariant* (frame independent), which means that each term in the Weber-Assis's force has the same value for *all* observers, even for the non inertial ones [2,3].

With the aid of equ. (1) and the Principle of dynamical equilibrium ("The sum of all forces of any nature

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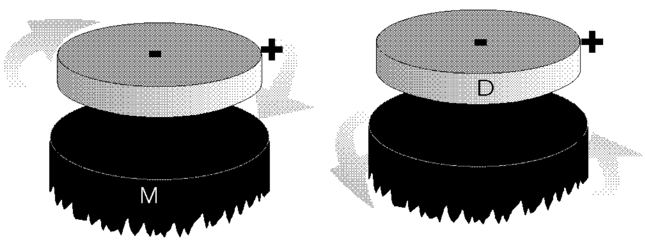

Figure 1: Homopolar induction only depends on the motion of M relative to D

acting on a body is always zero in all frames of reference") Assis was able to explain the origin of inertia and the reality of the so called fictitious forces of inertia (*-ma*, *centrifugal*, *Coriolis*, etc.). In short, Assis was able to develop a true relativistic mechanics, which comply with Mach's requirements. He coined the name *Relational Mechanics* when referring to his model.

The reactive force exerted by the whole isotropic Universe on an accelerated test particle k (gravitational mass m_{gk}) is worth $f_r = -m_{gk}\Phi a$ [7-10]. The above reactive force appears as opposing to the active, local force f_a which accelerated the test particle. Here $\Phi = \left(2\pi\xi\rho_g/3H_0^2\right)$, wherein ρ_g means the mean density of gravitational mass in the Universe and H_0 labels the Hubble's constant. On account of the Principle of Dynamical Equilibrium ($f_a + f_r = 0$) we get $f_a = -m_{gk}\Phi a \equiv m_{ik}a$, equation in which we have defined the inertial mass of the test particle ($m_{ik} = m_{gk}\Phi$) in order to recover Classical Mechanics.

As the (mean) density of inertial mass in the Universe also scales as inertial mass ($\rho_i = \Phi\rho_g$) and $\sqrt{G}$, we derive G $G \approx H_0^2/\rho_i$, a result first advanced by Dirac, based on numerological considerations[11].

Going into Electrodynamics, it was recently proven that electromagnetic induction is also a relational (i.e. true relativistic) phenomena [12-15], despite earlier statements that would implicate distant matter in its comprehension [16]. Beginning 21^{st} century we can ensure that a conducting disk (D) clockwise rotation upon a stationary uniform magnet (M) is equivalent to a magnet counterclockwise rotation with the disk at rest in the lab (figure 1), despite being $\partial\mathbf{B}/\partial t$ at each point in the space.

C Concluding remarks

As far as we know, the implication of a preferred frame of reference in which "the preponderance of the mass of the Universe is at rest" [16,17] holds true when dealing with the inertial reaction of the whole Universe opposing to locally applied active forces on a test body. The above-preferred frame appears to be superfluous when dealing with Electrodynamics.

References

[1] E. Mach. "The Science of Mechanics — a critical and Historical account of Its Development." Open Court, la Salle, 1960.

[2] A.K.T. Assis. "Weber's Electrodynamics." Kluwer, Dordrecht, 1994.

[3] A.K.T. Assis, "Relational Mechanics." Apeiron, Montreal, 1999.

[4] E. Schrödinger. "Die erfúllbarkeit der relativitätsforderung in der klassischen mechanik." *Annalen der Physik*, 77, 325–336 (1925).

[5] J.B. Barbour & H. Pfister. "Mach's Principle — From Newton Bucket to Quantum Gravity," pp. 147–158, Birkhäuser, Boston, 1995.

[6] A.K.T. Assis. "On Mach's principle." *Found. Phys. Lett.*, **2**, 301–318 (1989).

[7] J. Guala-Valverde. "Inertial Mass in Mach-Weber-Assis Theory." *Apeiron*, **6**, 202 (1999).

[8] J. Guala-Valverde & J.E. Guala, Jr. "Again on Inertial mass and Gravitational Mass." *Physics Essays*, **12**, 785–787 (1999).

[9] A.K.T. Assis & J. Guala-Valverde. "Mass in Relational mechanics." Apeiron, **7**, 131–132 (2000).

[10] J. Guala-Valverde. "A New Theorem in Relational Mechanics". Apeiron, **3**, 132–138 (2001).

[11] P.A.M. Dirac. "A New Basis for Cosmology." *Proceedings of the Royal Society of London*, A, **165**, 199–208 (1938).

[12] J. Guala-Valverde. P. Mazzoni & R. Achilles, "The Homopolar motor, a True Relativistic Engine." *Am. J. Phys.*, **70**, 1052–1055 (2002).

[13] J. Guala-Valverde. "Spinning Magnets and Relativity." *Physica Scripta*, **66**, 252–253 (2002).

[14] J. Guala-Valverde. "Feynman Lectures, *A-field* and Relativity in Rotations." *Spacetime* & *Substance*, **3** (2), 94–96 (2002).

[15] J. Guala-Valverde. "On the Electrodynamics of Spinning Magnets." *Spacetime* & *Substance*, **3** (3), 140–144 (2002).

[16] W.K.H. Panofsky & M. Phillips. "Classical Electricity and Magnetism." Addisson wesley, New York (1955).

[17] W.K.H. Panofsky, "Private communication." Letter to J. Guala-Valverde (1995).

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NEW BOOKS

"PUSHING GRAVITY: NEW PERSPECTIVES ON LE SAGE'S THEORY OF GRAVITATION, edited by Matthew R. Edwards.[1] Publ. by C. Roy Keys Inc., Monreal, Canada, 2002, 316 pp."

Since Newton's time many have proposed that gravitation arises from the absorption by material bodies of minute particles or waves filling space. Such absorption would cause bodies to be pushed into each other's shadows. The principal early proponent of this idea was Georges-Louis Le Sage. This book explores:

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The publication details are as follows. The book is issued under the Apeiron imprint, and published by C. Roy Keys Inc (Monreal, Canada). It is available in paperback only and contains 316 pages of essays and a four-page preface. The ISBN is 0-9683689-7-2, and list price is $25US. It can be purchased online at http://redshift.vif.com, and from major Internet retailers.

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References

[1] F.W. Stecker, K.J. Frost, *Nature*, **245**, 270 (1973).

[2] V.A. Brumberg, "Relativistic Celestial Mechanics", Nauka, Moskow, 1972 (in Russian).

[3] S.W. Hawking, in: "General Relativity. An Einstein Centenary Sutvey", eds. S.W. Hawking and W. Israel, *Cambr. Univ. Press*, Cambridge, England, 1979.

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