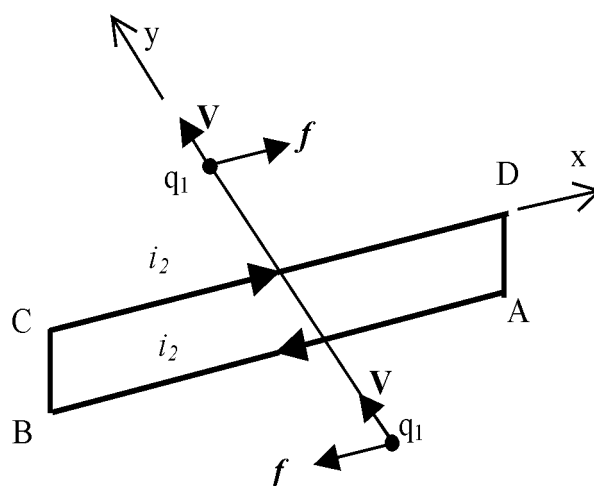


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ELECTRODYNAMICS: THE CONSISTENT FORMULAS OF INTERACTION FOR A CURRENT ELEMENTS, MOVING CHARGES AND NEW EFFECTS

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Using some original models for mental experiments it have shown that official electrodynamics contradicts all principles including the law of conservation of center of gravity, impulse, impulse moment for cycle, energy in closed system. I have obtained the new formulas for interaction force between current elements, which ensure observance of all principles. It has allowed revealing a series of new effects: dependence of a conductor inductance on the value of an adjacent uncompensated static charge, emergence of EMF in a current loop (which may be bifillary) at the moment of value alteration of adjacent charges, transformation of DC from one external source-supplied bifillary loop to another common loop at asymmetrical position of loops and change of signal propagation velocity along a two-conductor line with a static charge stationed nearby.

1. Introduction

For dozens of years I cannot achieve admission of my theory in spite of the fact that nobody can disprove my arguments and results obtained! My last manuscript was published after five years in editorial portfolio, the first one waited publication for 9 years and some of them have not been published at all.

Last decades the number of scientists is growing who oppose “mad ideas,” i.e. ideas ignoring common sense and philosophical views. Such scientists correctly suppose that “physical theory proved unable to really help practice in solution of new urgent problems proposed by life itself... theoretical search by physicists becomes more and more far from reality” [1].

Preservation of only some experimentally proven formulas that can be explained in other ways, without “mad ideas,” the rest being perished, cannot save the dogmatic theory.

But in electrodynamics, which was a cradle of relativity theory, the situation is much worse than in other areas, and at all levels. For already about 200 years nobody can discover non-contradictory laws of electrodynamics.

An attempt to solve the contradiction was rejection of Newton’s law requiring action and counteraction to be equal and its substitution for the law of conservation of total impulse of interacting bodies and the field [2, pp. 132–136].

This is the way that electrodynamics scientists try to justify dissymmetry of all components of electro-

dynamic forces in interactions between subsystems.

From electrodynamic point of view all components of force (except Coulomb’s) are dissymmetrical even under interaction between a moving and a stable charge: the moving charge does act upon the stable one, but not visa versa! [3, pp. 209–212; 4, pp. 124, 125, 212, 213].

At the same time it is known from history of physics that during creation of interaction laws some experiments were performed with open-circuit currents because for closed-circuit currents all theories gave an identical result [5, p. 110].

“The law established by Ampere is different from the law of interaction between two current elements nowadays known as Ampere’s law... The blunder committed by Ampere did not alter the results of calculation because the law was naturally applied to simple cases of definition of interaction between closed-circuit conductors with direct currents. In this case both formulas give an identical result because their difference is a value which after integration along a closed circuit gives zero” [6, p. 279].

Some unique calculation models for mental experiments discovered by me helped me to prove [7–14] that the laws-formulas of electrodynamics even at small velocities (quasistationary case) contradict the laws of conservation of impulse, gravity center, energy and closed system impulse moment and, thus, are erroneous.

2. Infringement of principles in an official electrodynamics

Let us consider my model in this plane, which I many times used in my works and which completely denies electrodynamic formulas of interaction force.

Let a charge fly from $-\infty$ over a vertical current circuit perpendicular to its plane (the current being significant). As in this case magnetic field of the conductor over whose central part the charge flies is many times larger than magnetic field of the charge, by electrodynamic principles the field impulse may appear only when electric field of the charge and magnetic field of the current conductor cross in the same spatial volume. When the charge is in $-\infty$ those fields are separated and the field impulse is zero. When the charge approaches the conductor it is acted upon by a force perpendicular to its velocity and directed opposite to velocity of a charge of the same sign in the conductor. But this force never acts upon the conductor according to the electrodynamic formula (it is acted upon only by a small moment of force). Therefore, the center of gravity of charge-conductor system acquires an impulse and moves towards the force acting upon the charge. Simultaneously when the charge approaches the conductor some intersecting electric and magnetic fields emerge in a spatial volume and, according to the electrodynamic principle, the field acquires an impulse of identical value and opposite sign. When the charge comes to infinity this additional impulse of matter and field becomes zero, as zero comes the charge lateral velocity. But the charge has already moved towards the first force that acted upon the charge when it approached the circuit. So it turns out that gravity center of a closed system has moved!

If this charge in infinity alters its velocity to reverse and comes back to minus infinity along the same trajectory but in a reverse direction, the system center of gravity will move to the same direction. This means that while shuttling forwards and backwards even at a local section of the trajectory this charge according to the laws-formulas of electrodynamics must continuously move the center of gravity of a closed-loop system consisting of a conductor and a charge, therefore, this effect cannot refer to local effects of a dissymmetrical component caused by final velocity of interaction propagation. Thus, even conservation of impulse cannot help because another law is violated — the law of conservation of a closed-loop system center of gravity! My model of mental experiment is especially important by itself as it convincingly denies electrodynamic laws and notions. Nobody could disprove my arguments. In order to keep to the law of conservation of a closed-loop system center of gravity a moving charge must act upon current-carrying charges along or opposite to their movement depending on the charge approaching or moving away

from the conductor. Using a similar model one can show that not only time-alternating current acts upon a stable charge, but a stable charge must also act upon current-carrying charges when current alters with time. For instance, if in a given system current is given not before, but during passage of the charge over it, this charge will acquire an impulse which diminishes to zero as the charge is coming to infinity. In this case in order to retain the system center of gravity it is necessary for the current growing in the loop to get an impulse which would diminish to zero when the charge goes to infinity, as well as the latter's impulse.

But this model is not all. In spite of the fact that interaction forces between moving charges depend on velocity square and are neglectably small due to small value of both charges and their velocity of one of them as compared to Coulomb's forces and cannot be fixed because of the same Coulomb's force, even such a model can show inconsistency of modern electrodynamics.

If, for instance, under a stable charge q_1 a charged disk rotates around a vertical line crossing the charge q_1 , then all perpendicular to the plane of this circle components of forces acting from the side of the small rotating disk upon the stable charge and from the side of stable charge upon the rotating disk being unequal, as electrodynamics states, the total impulse and center of gravity of the whole system would not only conserve, but constantly grow. Besides [7, 8], if a charge is over a closed-loop rectangular bifillary current circuit (i.e. over isolated direct-current and reverse-current conductors laid together or a plurality of such pairs), then, as from such a circuit a force, though neglectably small, acts upon the charge, any movement of the charge closer or farther from the bifillary circuit must cause a change in velocity and energy of current carriers in the conductor, add or take away energy to the source of electric energy supplying the conductor. From the other side, from the point of view of electrodynamics, the energy of circuit-charge system and power consumption of the source supplying the circuit will remain invariable as magnetic field of a bifillary circuit is to be zero. And electrodynamic formulas give zero force acting from a stable charge upon a moving one, whereas the force acting from a moving charge upon a stable one must not be zero. Thus, in this respect dissymmetry refers not to separate force components, but to all of them!

Thus, we have the law of energy conservation violated by electrodynamics law even in a quasi-stationary case.

3. The new formulas for interaction force between a current elements and between a moving charges

Using unique calculation models, both containing special points and not, I have obtained a formula for in-

teraction force between current elements [8, 14] — not as one of multiple equal functions [5, 6, 16, pp. 206, 207] which differ in a component giving a zero value at integration along closed loop, but as a defined, strictly proven by me many times, symmetric function. Its being substituted for an electrodynamic one leads to violation of the law of preservation!

My formula for interaction force between current elements has a form

$$\mathbf{f}_{21} = \frac{\mu\mu_0}{4\pi r^3} [-\mathbf{r}_{21} (d\mathbf{l}_1 \cdot d\mathbf{l}_2) + d\mathbf{l}_2 (d\mathbf{l}_1 \cdot \mathbf{r}_{21}) + d\mathbf{l}_1 (d\mathbf{l}_2 \cdot \mathbf{r}_{21})]. \quad (1)$$

It is the only possible one and differs from electrodynamic formula of force acting from a second element upon a first one in presence of an additional third term which defines the longitudinal component of the force acting upon an element acted upon by the force. This third term turns zero during calculation of the force acting from a closed loop upon a current element, or the basic force acting from the closed loop upon the charge, but it does not turn zero during definition of a force acting from the current element (or the basic force acting from a moving charge) upon the current loop. Therefore, as distinct from electrodynamic one, it provides for non-violation of the laws of conservation! The forces acting upon each of interacting current elements (or basic component forces of interaction between current element and moving charge) are of equal value and opposite direction.

As f_{21} defines the force acting from dl_2 upon dl_1 , radius vector \mathbf{r}_{21} is directed from dl_2 to dl_1 .

The above formula is a particular case of my more general formula for interaction force between moving charges [8, 13, 14] which may for at least small velocities in vacuum together with Coulomb's force be written as:

$$\begin{aligned} \mathbf{F}_{21} = & \frac{q_2 q_1}{4\pi\epsilon_0 r^3 c^2} \left[\frac{1}{2} V_1^2 \mathbf{r}_{21} + \frac{1}{2} V_2^2 \mathbf{r}_{21} - \right. \\ & - (\mathbf{V}_1 \mathbf{V}_2) \mathbf{r}_{21} - \mathbf{V}_1 (\mathbf{r}_{21} \mathbf{V}_1) + \mathbf{V}_1 (\mathbf{r}_{21} \mathbf{V}_2) + \\ & \left. + \mathbf{V}_2 (\mathbf{r}_{21} \mathbf{V}_1) - \mathbf{V}_2 (\mathbf{r}_{21} \mathbf{V}_2) + c^2 \mathbf{r}_{21} \right], \quad (2) \end{aligned}$$

where \mathbf{f}_{21} is force acting from q_2 upon q_1 ; ϵ_0 is electric constant; c is light velocity.

Coulomb's force is determined by $c^2 \mathbf{r}_{21}$ in brackets.

Not hard to see that this formula also provides for equality of value and opposite directions of charge interaction forces, thus, it does not violate the laws of preservation and at the same time never contradicts well-known experimental facts! But this is not all! At substitution of $\mathbf{V} = \mathbf{V}_2 - \mathbf{V}_1$ it is expressed solely via relative velocity... Formula (4) at $\mathbf{V}_1 = 0$ relative to \mathbf{V}_2 takes the same form, thus, is independent from reference system... This denies modern electrodynamics and requires reviewing the relativity theory... At substitution of relative velocity $\mathbf{V} = \mathbf{V}_2 - \mathbf{V}_1$ to formula

(4) it turns into formula (5) where the force depends only on relative velocity:

$$\mathbf{F}_{21} = \frac{q_2 q_1}{4\pi\epsilon_0 r^3 c^2} \left[\frac{1}{2} V^2 \mathbf{r}_{21} - \mathbf{V}_3 (\mathbf{r}_{21} \mathbf{V}_3) + c^2 \mathbf{r}_{21} \right]. \quad (3)$$

If charge velocity alters with time, formulas (4) or (5) include a component

$$\Delta_1 \mathbf{F}_{21} = \frac{q_2 q_1}{4\pi\epsilon_0 c^2} \left[\frac{(\mathbf{a}_2 - \mathbf{a}_1)}{r} - \Psi_{(a)} \right], \quad (4)$$

where $\mathbf{a}_1 = \frac{\partial \mathbf{V}_1}{\partial t}$; $\mathbf{a}_2 = \frac{\partial \mathbf{V}_2}{\partial t}$; $\Psi_{(a)}$ is function connected with alternating Coulomb's field and in general case different from electrodynamic $\varphi_{(a)}$, but also suppressing the component of vibrator electromagnetic field bi-directional along its axis at distant area... The first term of (8) depends not on absolute acceleration, unlike electrodynamic, but on relative one...

In some cases a compensatory term $\Psi_{(b)}$ different from electrodynamic $\varphi_{(a)}$ may be added to formulas (4) and (5).

In calculation of force acting from the closed loop upon a moving charge, from moving charge upon closed loop, from stable charge upon moving charge $\Psi_{(b)}$ in this approximation is zero... And $\Psi_{(a)}$ is zero, for instance, when at distant area a non-accelerated charge acts upon an accelerated one, when an AC element of closed loop acts upon a non-accelerated charge, or a current element, or a vibrator. In calculation of total force acting upon a neutral subsystem with uniformly distributed positive and negative charges $\Psi_{(a)}$ and $\Psi_{(b)}$ may be treated as zero...

For comparison to my formula (4) I cite an opposing electrodynamic formula (10) which is obtained by substitution in electrodynamic formula [3, pp. 209–212] and [4, pp. 124, 125, 212, 213] and their transformation to a form most convenient for small velocities:

$$\begin{aligned} \mathbf{F}_{21} = & \frac{q_2 q_1}{4\pi\epsilon_0 c^2} \left[\frac{1}{2} \frac{V_2^2 \mathbf{r}_{21}}{r^3} - \frac{(\mathbf{V}_1 \mathbf{V}_2) \mathbf{r}_{21}}{r^3} - \right. \\ & \left. - \frac{\mathbf{V}_2 (\mathbf{V}_1 \mathbf{r}_{21})}{r^3} - \frac{3}{2} \frac{(\mathbf{V}_2 \mathbf{r}_{21})^2 \mathbf{r}_{21}}{r^5} + \frac{c^2 \mathbf{r}_{21}}{r^3} \right]. \quad (5) \end{aligned}$$

When charges move with acceleration this electrodynamic formula is supplemented with an electrodynamic component (11) opposed to my additional component (8). The additional electrodynamic component (11) has a form:

$$\Delta_{01} \mathbf{F}_{21} = \frac{q_2 q_1}{4\pi\epsilon_0 c^2} \left[\frac{\mathbf{a}^2}{r} - \frac{(\mathbf{a}_2 \mathbf{r}_{21}) \mathbf{r}_{21}}{r^3} \right], \quad (6)$$

and $\varphi_{(b)}$ may be also added...

The second term of formula (11), i.e. $\varphi_{(a)}$ as well as $\varphi_{(b)}$ are calculated by electrodynamic scientists from lagging vector and scalar potentials...

As we see, the electrodynamic formula (10) is not a symmetrical one and, therefore, violates the laws of conservation, as demonstrated above, including the law of closed system center of gravity.

4. Conclusions

Using unique models for mental experiments I have shown that:

- official electrodynamics contradicts all principles, including the laws of conservation of closed system center of gravity, its impulse, impulse moment per cycle, energy;

- the statement of modern electrodynamics that in the law of interaction between subsystems equality of action and counteraction may be unconserved and, therefore, the third Newton's law should be substituted for the law of matter and field impulse preservation, is valid on a disproportionately narrower scale than one permitted by the laws of electrodynamics and only as a direct consequence of final interaction propagation velocity. In order not to violate the laws of conservation, the basic components of interaction force must have symmetrical forms. This basic interaction force may be expressed via relative velocities of charges.

- for subsystems whose position did not and does not alter with time Newton's law must be preserved and all components of interaction force in this case must, moreover, have a symmetrical form, but this is not provided by electrodynamics!

- my results include also the laws of interaction, which never contradict experimental facts, provide for preservation of all the laws of conservation and permit prediction of new effects.

Additionally to the above, the result obtained allows presentation of inductance as a factor of relative charge acceleration and revelation of a number of effects emerging when carriers of the same sign prevail in a conductor and depending on carrier density. Such effects are as follows:

- dependence of a conductor inductance on the value of an adjacent uncompensated static charge;

- emergence of EMF in a current loop (which may be bifillary) at the moment of value alteration of adjacent charges or a charge-loop distance alteration;

- transformation of DC from one external source-supplied even bifillary loop to another common loop at asymmetrical position of loops: up to now this effect (Meissner effect) has been observed only at external magnetic field - from a permanent magnet or common, but never bifillary, current loop;

- change of signal propagation velocity along a two-conductor line with a static charge stationed nearby, the charge sign relative to the sign of two-conductor line current carriers determining the sign of effect. For metal conductors a negative charge will reduce induc-

tance and, this, increase signal propagation velocity! Those effects as well as the above formulas have been described in my published works.

Note... Direct current may, for instance, be transformed under axial symmetrical arrangement of a superconducting loop over a bifillary current loop (the loops being in the same plane). A potentially superconducting non-bifillary current loop being cooled, a current must emerge there with a direction dependent not on current direction in bifillary loop, but on the sign of its carriers and non-bifillary loop carriers.

This current may be fixed both by teslometer and by emergence of an inductive EMF during heating of this superconducting loop, for instance, by quick evaporation or coolant drainage. A drop of this current causes EMF in the metering sensor. This sensor may be connected to a ballistic EMF measurement system with an amplifier, measuring $\int E dt$.

Appendix 1

In 1968-1969 some scientific and popular scientific magazines of the USSR published a series of reports and discussions relating to inconsistency between the electrodynamic formula of interaction force between current elements - short current conductors (Grassmann's formula or, as they incorrectly call it, second Ampere's formula) and mechanical principle of equality of action and counteraction. This inconsistency is quite obvious when we study interaction between two mutually perpendicular current elements within the same plane, one of them lying over the center of the other (directed to central point of the other but never crosses it). In this case according to the electrodynamic formula the second current element acts upon the first one, creating a force directed to one side, whereas the first element does not act upon the second one, i.e. does not create in the second element any force directed opposite to the force acting upon the first current element... Publications and discussions touched both theoretical and philosophical problems and the possibility to create unique electromechanical design contradiction the laws of mechanics. Typical for this discussion was an article by V. Okolotin, Cand.Sc. (Techn.) under the title "One Hundred and Fifty Years of Hypnosis. Ampere's Blunder Corrected by Physicists from Fergana" in *Technika molodezhi* magazine, 1968, Issue 12.

Theories and design of physicists from Fergana proved to be erroneous, but the discussion caused by them turned to be very useful, and their criticism of contemporary electrodynamics was correct, but too incomplete as it related only to a simple subsystem without analysis of global systems and principles. In his work "New Studies of Magnetic Field Moving Forces," Tashkent, Nauka Publishers, 1965 R. Sigalov, the leader of Ferghana physicists, wrote: "It is known that vec-

tor sum of magnetic interaction between a pair of elements can be not zero according to Grassmann. On this some authors express amazement and think that Grassmann's formula is inapplicable to such cases. Others argue that Grassmann's interaction of current elements is deprived of physical sense and only the results of integration along closed loop reflect natural phenomena correctly. Still others state that Grassmann's formula is only a part of correct force evaluation and some terms that disappear when integrating along closed loop have been omitted in it. Many authors: abstain from statements relating to interaction forces at end sections of current circuits... The urgency of problem is not eliminated by the fact that summing of such forces for a singular closed circuit gives zero: the laws of dynamics must be kept to for not only the whole system but for its parts as well.

Besides, electrified bodies move along non-parallel ways. Thus, the sum of Lorentz's forces is not zero. And no closed current circuit which could somehow divert from this unpleasant circumstance is possible."

To the "still others" belong Academician I.E. Tamm, Nobel Prize winner. As early as in 1929 he expressed a statement that was later reflected in "History of Physics" (P. Kudryavtsev, 1948) and "Fundamentals of Theory of Electricity" (I.E. Tamm, 1957): "within the limits of studies of closed direct currents the interaction force of current elements cannot be determined simply: if we alter the current interaction law by addition of some terms, the integration of which along closed current is zero total force acting upon the element from the closed current remains unchanged."

But contrary to closed currents, open currents cause not only magnetic, but electric fields as well. And electrodynamics has on a par with matter impulse, i.e. impulse of interacting subsystems, has a notion of electromagnetic field impulse, its density as well as field energy density in a given point (more exactly, in a given microvolume) of space is proportional to vector product of electric and magnetic intensities in the given point (Pointing vector).

Thus, electrodynamic scientists have declared that in the case of open currents and moving charges forces may be unequal in value and inopposite in direction, but the total value of field and matter impulse must be preserved.

At the same time electrodynamics admits that forces cannot act upon a field! All authors admit this. "All attempts to disclose any manifestation of such forces proved fruitless" (A. Borisov, Action and Interaction, *Izobretatel i ratsionalizator*, 1968, Issue 4). "Radiation or absorption of energy by a field at currents which alter only slightly with time is impossible" (*Tekhnika molodezhi*, 1969, Issue 8).

Referencing to field impulse one can accumulate a whole batch of folly. From the electrodynamic point of view all force components, except Coulomb's one are

asymmetrical even under interaction of a moving and a stable charges: a moving charge acts upon a stable one, whereas the stable charge does not! But that is not all. Electrodynamics is closely connected to relativity theory, and in this science forces depend on reference systems.

For instance, if two charges move parallel to each other with equal velocities, an imaginary line connecting them being perpendicular to their velocity, from the electrodynamic point of view only Coulomb's repulsion force and nothing else exists for an observer moving together with those charges. At the same time for a stable observer additionally to Coulomb's another attraction force exists, its absolute value being twice less than respective specific attraction of two current conductors (L.D. Landau, Ye.M. Lifshits, Theory of Field, vol.2, 1973, pp. 124, 125). The second half is added from interaction of moving charge in one conductor with stable positive charge in another one. The force acting upon moving charge in one conductor from stable charge in another conductor (except Coulomb's) is absent! At the same time from the point of view of my electrodynamics between two charges immovable relative one to other only Coulomb's forces act in any reference system. To tell the truth, acceleration has two components — absolute and relative ones... But they have nothing to do with reference systems!

It is interesting that electrodynamics also envisages only Coulomb's forces between two charges moving in parallel with equal velocities, but only: if the charges are borne in infinite non-conducting rods which move in parallel with equal velocities (J. Cronin, D. Greenberg, V. Telegdy, Physical Problems with Solutions, M., Atomizdat, 1971, pp. 33, 177) the translation from English. It is so because electrodynamics with relativity theory provide for increase of charge density due to Lorentz length reduction... But if near each moving rod we put a stable one with equal number of charges of opposite sign and treat the adjacent moving and stable rods as a single subsystem, the interaction force between subsystems will be twice less than interaction force of respective current conductors! Because in electrodynamics a moving charge acts upon a stable one, but not visa versa, if not for Coulomb's force. But in my electrodynamics, immovable relative one to other, act to each other only with Coulomb's force.

But in each subsystem additionally to Coulomb's force some new forces emerge from action of a moving charge upon a stable one and visa versa. That is why it always matches logic and experimental data. I have obtained its laws of interaction quite strictly from equations based on laws of preservation and common sense. That is why my teaching is free of follies when an additional force opposite to Coulomb's one emerges at laboratory reference system between two charges moving in parallel with equal velocities whereas it never appears between charged rods moving in parallel!

And most important: as I have proven the laws of electrodynamics may lead to shift of a closed system center of gravity, even a continuous one, and thus violate the law of energy preservation!

And what about relativity theory which is a single system with official electrodynamics? The dependence between energy and velocity used in relativity theory is undoubtedly correct in a very wide range. But this formula in various interpretations and with various coefficients was obtained before establishment of relativity theory and can be qualitatively explained by self-action of single or multiple charges under acceleration due to finite interaction propagation velocity... Another matter that physicists are still unable to provide for necessary coefficients... (R. Feinman et al., Feinman's Lectures on Physics, Issue 6, M., Mir Publishers, 1966, pp. 306–314, 320, 321).

But energetic difficulties appearing when a body accelerates to large speeds cannot forbid superluminal relative velocities!

It must be noted that “We lack direct experimental confirmation of constant character of light velocity even now. Some experiments when light before measurement comes through translucent medium or is reflected cannot pretend to do this because those refraction and reflections affect the subsequent light movement quite substantially... Observation of double stars is not a direct experimental proof of constant character of light velocity either. We can admit that after radiation light velocity is added to star velocity. Then during propagation in space under effect of interstellar medium, gravity fields, etc. this velocity gradually alters and strives for its constant value typical for interstellar space conditions. If the time of “velocity equalizing” is not too large, this dependence of light velocity on the source velocity may remain unnoticed in observation of double stars” (A.N. Matveyev, *Electrodynamics and Relativity Theory*, Moscow, Vysshaya Shkola Publishers, 1964, p. 301).

Nowadays there are many opponents of relativity theory. “Physicists from Moscow University have shown that Einstein's gravitation theory (general relativity theory) substantially lacks the laws of conservation connecting matter and gravity field... as... the theory in this aspect... does not have any Newtonian limit... the obtained... values characterize... only a particular choice of a coordinate system” (*Khimiya i Zhizn*, 1981, No 8, p. 19; references to: *Teoreticheskaya i Matematicheskaya Fizika*, 1980, vol. 45, p. 291; Preprint of USSR AS Nuclear Research Institute, Moscow, 1981, No 0139).

There are reports that “superluminal scattering of debris from some quasars has not yet been finally explained” (*Khimiya i Zhizn*, 1984, No 10, p. 94 - reference to *Popular Science*, 1984, vol. 224, Issue 4, p. 70).

As to non-absolute essence of time, this support of

relativity theory also does not have a direct proof. Time difference in half-decay of moving and stable mesons may be caused by various reasons. For instance, if fast radioactive mu mesons decay longer than stable ones because they were accelerated at initial and final sections of their paths or more intensely interacted with environment, it never violates common sense and is not connected to non-absolute time. But in all cases this effect can be explained in an easier way than the facts of violation of laws of conservation by official electrodynamics, which I cited above!

In any case we must not forget that “if a theory exploits one or several experimental facts it does not mean that absolute truth of this theory has been proven by itself... In relativity world pattern relations are absurdly absolutized. Depending upon relations of reference systems not only space, time, mass, energy, gravity, but the whole material world, a particular pattern of Universe, its structures and evolutions... Time in relativist formulas is obtained from correlation of velocities — luminous and mechanical... it is well known that altered motion of a clock does not change duration of other phenomena, external relative to this clock” (V.N. Dyomin, V.P. Seleznyov, *Perception of the World*, Moscow, Molodaya Gvardia, 1989, pp. 9, 51, 52).

Another author writes: “criticism of relativity theory in no way casts aspersions on its founder, great physicist Albert Einstein... First of all, his contribution to physics is quite enormous without his relativity theory, and Nobel Prize was awarded to him not for this theory... So when relativity theory is defeated it would be owing to Einstein as well.” (A.A. Denisov, *Myths of Relativity Theory*, Vilnius, LitNIITI, 1989, p. 50).

In this aspect I cannot help to cite the eloquent analogy from another branch.

In our time most people never exclude existence of a soul, or ego, which can or cannot exist separately from body... Having only Darwin's theory and even its modifications implying a possibility of provocations from environment and even guided mutations, the time of existence of Universe would not be sufficient for even a simple worm to appear... But even if they had enough time! Even if evolution could bear humans — a probability for each human to have his own ego would be zero! Whatever one could say of inapplicability of probability theory to unique events. If we suppose that emergence of a particular ego depends on genotype, phenotype, brain structure, type and frequency of electric currents in it and on many more things, then death of only one of multiple ancestors before conception of a subsequent one, other combination of a single couple, other time of conception and even victory of a wrong spermatozoon would make appearance of just this particular ego impossible. Doubles with identical appearance do not count — even monoovarian twins have different souls, i.e. different egos, even though interconnected by unknown

signals. The fact that each personality is created due to effects of unnatural forces may be proven by the circumstance that some people contain information of events taking place before their birth and at places where they have never been — even their ancestors were not among witnesses. Some connect such cases to soul memory, others to existence of a common information field of Earth... Evidence of ghosts also says to the benefit of existence of soul and living fields... On such and similar problems discussions, disputes and theorizing are quite logical.

However, if somebody tried to analyze properties and essence of field life and ghosts using laws of biology and physics, and terrestrial information field using cybernetics, adding mathematical equipment to natural laws, it would be difficult not to call this an idiocy, though how mathematically beautiful generalizing theory might appear. Because for unnatural events everything is possible. And even broad dress of mathematics would turn infinitesimally narrow... Natural laws differ from unnatural ones first of all in the fact those natural understandable models and explanations may in even far future explain the former, not using any supernatural fancies.

All said on natural and unnatural is directly connected to the problem of justification of relativity theory being related to a natural science — physics...

The use of mathematics for description of a physical theory violating the laws of conservation resembles the attempts to use the laws of biology and physics for description of biological objects and at the same time — properties of ghosts!

Appendix 2

I began analyzing principal laws of electrical processes and electrodynamics in 1953. I used the mental experiment method and node point analysis. For instance, I asked myself: if we have a load with a zero active impedance and an infinite inductive impedance connected to an ideal DC voltage source, the current must, although after an infinite time, become infinite, but if we connect this load to an AC voltage source the current will be zero... And what if we connect this load to an AC voltage source via an ideal diode? What kind of current will then be — zero or infinite? And can this system be expanded into a Fourier series? I used to find correct answers to such questions even before I solve differential equations and I was quite astonished to find out that great pundits are at loss before such simple questions...

But when in 1953 I began studying paradoxes of electrodynamics I saw that nobody could be called a real specialist in this field. Having been convinced that the laws of interaction between electrodynamic subsystems and many principles of electrodynamics are incor-

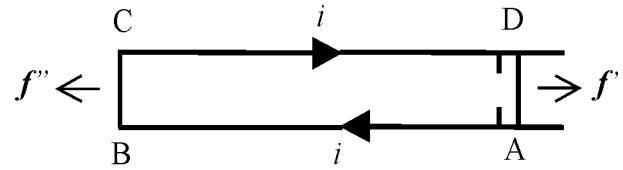


Figure 1: Rectangular contour with a current, at which length of the side of one pair (CD and BA) many times over exceeds length of the side of the second pair

rect I began to create new electrodynamics...

In this the basic component of interaction force between moving charges depends on relative velocity. But unlike Gauss, Weber and the like formulas, it does not contradict experimental facts and contains some components dependent on absolute parameters of movement. But common sense is not at all violated at this. A continuation of my electrodynamics is besides incorrectness of official electrodynamic law of radiation as proven by me and my new law — quite an untrivial one! Besides, my electrodynamics permits to reveal some effects not envisaged by official electrodynamics and more than globally important for the fate of modern physics...

In 1959 I qualitatively substantiated the necessity of dependence of a conductor inductive impedance on the value of an adjacent uncompensated electric charge and, accordingly, a possibility to increase the velocity of electromagnetic waves propagation along a two-conductor line if nearby and along its wires a static charge is situated with an identical sign with that of current carriers, I submitted a respective text to Academy of Science of the USSR and received a negative reply signed by S.I. Sukhoruchkin, Cand. of Sc. (Phys. And Math.) (Ref. No 4587/97 of 24.11.1959).

My article "On Effect of Conductor Inductive Impedance Dependence on Static Charges" sent to *Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (Inc. No 512 of 28.07.1965) was not published. A similar reply went from *Elektrichestvo* magazine editors (reply dated 7.06.1966). I could not find out the fate of my letter sent in 1965 to Prof. L. Infeld in Poland.

A similar text filed as a discovery application to State Committee on Inventions and Discoveries of the USSR (No 32-OT-4654) was not taken for consideration (replies signed by V. Tsaregorodtsev of 30.09.1965 and F. Ananyev of 10.09.1965).

In 1971 I filed a new discovery application where I specified my formula for interaction between current elements and a more generalized one for moving charges. There some effects were also described not envisaged by classic electrodynamics. Negative reply from Research Institute of Patent Examination (No OT ED 387 of 6.05.1971) was signed by N. Turkov, Deputy Head of Preexamination Department.

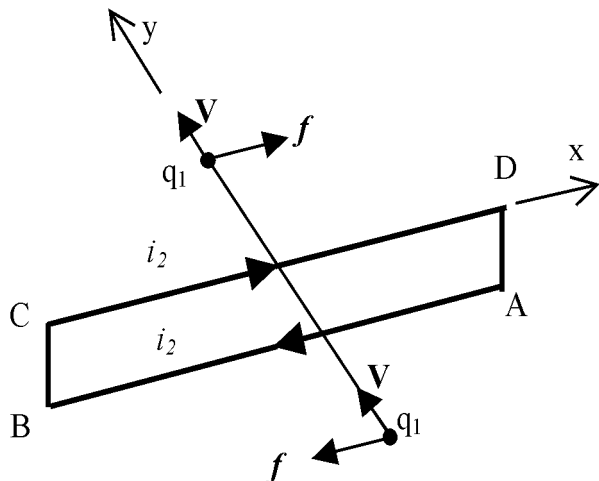


Figure 2: The travel of an electrified body q_1 on a trajectory (along an axis y) above a rectangular contour with a current is perpendicular its planes

At least, my third discovery application was received for consideration (No OT-8010 of 24.05.1971).

In this very year similar texts were rejected by magazines *Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki* (Inc. No 387 of 25.05.1971, insipid reply No 1274 of 09.09.1971) and *Tekhnika-molodezhi* (reply of 29.08.1971 signed by part-time editorial employee V. Okolotin).

The basic argument for the latter to reject my manuscript was presence of a longitudinal force in my law of interaction, i.e. a force acting along a current element upon which it acts!

In 1979 my discovery application was at last received for consideration (OT-10089 of 02.07.1979). However, in all those cases I got formal repudiation, though nobody could prove that I was wrong, even Institute of Electrodynamics in Kiev...

In *Izvestiya Vuzov SSSR, Elektromekhanika*, 1980, Issue 4 my article was published where I specified my law of current elements interaction, which I was unable to publish since 1971! Using the example of that formula I demonstrated my method of expression of a physical law as simple and the only correct one, using a model with a special mathematical point at which only correct formula does not cause a mathematical paradox!

My manuscript "On Some Contradictions in Electrodynamic Laws of Interaction" was deposited at *Izvestiya Vuzov SSSR, Elektromekhanika*, Novocherkassk, 1981, 10 pp. with fig., Dep. on 25.11.1981, No 377-d/81, Monthly Bibl. Directory No 3/125/M.1982, inf. No 369 of VINITI.

In this article I showed with the help of simple models that additional contradictions emerge at application of not only electrodynamic expression of interaction force between current elements, but also of electrodynamic expression of moving charge electric field intensity and interaction force between moving charges, and these can be obliterated only by correction of those

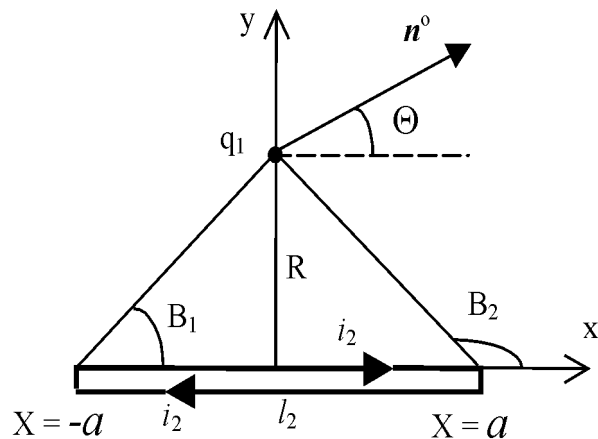


Figure 3: The bifilary contour with zero distance between conductors of direct and reverse current (length of each conductor is l_2) with located above it by the charge q_1

laws...

Particularly:

— in interaction with current of sides of a loop (Fig. 1), one pair of such sides being much longer than the other one, equal and oppositely directed forces acting upon short sides emerges from being acted upon by long sides, the latter not being acted upon by short ones... If we divide such a loop with a sliding contact into two subsystems, one of which consists of a short side and the other one consists of two long and one short sides, according to official electrodynamics the force acting upon the second subsystem and providing for equality between action and counteraction in the whole system does emerge from interaction of three sides within the same subsystem? It is quite a folly in physical sense;

— in considering an interaction of two subsystems (Fig. 2), one of which is a vertical rectangular DC loop, and the other one consists of a charge flying from to over central part of this loop horizontal side, the electrodynamic formula of interaction force, even with field impulse taken into account, leads to the closed system center of gravity not being conserved!

— if we consider a system consisting of a bifilary current loop (the first subsystem) over which an electric charge (the second subsystem) is suspended (Fig. 3), then the charge being moved to infinity gains a certain energy... At the same time according to official electrodynamics it would not change the energy of bifilary loop, as according to official electrodynamics it wouldn't influence to the loop's current and it's inductance, the inductance of bifilary current loop is considered to be always zero.

My article "On Problem of Alternative Laws of Currents and Moving Charges Interaction and Some Concomitant Electrodynamic Effects" was deposited at Informelektro Institute, 118ET-84 Dep., VINITI Information Publication Deposited Scientific Papers No 9, p/116? Reg. No 535, 1984. In this article both my

interaction force formulas were specified: the first one — between current elements, and the generalized one — between moving charges...

These formulas were contained in my discovery applications many times submitted to Patent Office in 1971, including No OT-8010 of 24.05.1971 taken for consideration. Abstract was published in *Izvestiya Vuzov SSSR, Elektromekhanika*, 1984, Issue 9 where my second formula was specified and my newly discovered effects not envisaged by official electrodynamics were described!

In VINITI Institute an article by G.V. Nikolayev from Tomsk Polytechnic Institute was deposited (No 528-79 Dep) where under No 71 and 72 he cited my first formula for current elements interaction force which he wrote down from my manuscript submitted to *Tekhnika-molodezhi* in 1971 and not published by that time. Fortunately, this formula was specified in my registered discovery application No OT-8010 of 24.05.1971. My second generalized formula of interaction force between moving charges, including the first formula as a particular case, was also specified in this application but not used by G.V. Nikolayev. Early in 1980s G.V. Nikolayev visited me for consultations and asked to explain my formulas to him: and the results of their application... I spent several hours on that... He gave me his deposited manuscript and admitted that this formula belonged to me!

By initiative of V.S. Okolotin in *Tekhnika-molodezhi*, 1984, Issue 1 a version of my article was published with my first interaction force formula, i.e. force of interaction between current elements, and some effects were described. Mr. Okolotin improved my style, made it more acceptable for a popular magazine, for which I am extremely grateful to him.

At the same time my articles sent again to *Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki* (No27a, 24.01.1985) were repudiated as well (letter by Editorial manager N.I. Yankelevich of 11.04.1985).

My article "On an Evaluation Method of Correctness of Electrodynamic Formulas of Interaction Based on Analysis of Force Values at Special Points" was published in *Izvestiya Vuzov SSSR, Elektromekhanika*, 1991, Issue 1. Before that it was submitted under the title "On Emergence of a Mathematical Paradox at Application of Ampere's Electrodynamic Formula" to *Fizika* magazine on 17.02.1984 and groundlessly refuted by an anonymous reviewer and Chief Editor Prof. V.N. Detinko.

In this article on a par with my already published special point model, which was used to obtain my formula for interaction force between current elements, I specified my unique model without a special point allowing to reach the same goal... The latter model is a loop consisting of two adjacent concentric semi-circles connected with two segments of diametrical straight lines and a vibrator at center of continuation of those

segments directed perpendicular to the plane of this closed loop... The vibrator and the loop are mutually symmetrical at different planes... If the loop is connected in series to a DC source and then an increasing unipolar voltage is fed along a coaxial cable to the vibrator so that currents of the loop and then the vibrator were constant for a certain length of time, after that the loop and then the vibrator being switched off, then in definition of interaction forces and inductive forces acting upon the charges and of their moments we can prove that only my formula of interaction force between current elements does not contradict the laws of preservation!

I must add that in *Elektromekhanika* my article was waiting publication for about 6 years, possibly because V.I. Astakhov, Leading Scientist at Novocherkassk Polytechnic Institute and member of editorial board, committed an error in his previously published article as he clung to the erroneous view of I.E. Tamm... Particularly in his article (V.I. Astakhov, On Discussion of the Formula of Electrodynamic Interaction between Current Elements," *Izvestiya Vuzov SSSR, Elektromekhanika*, 1983, Issue 10) he refers to my article in Issue 4, 1980 and says that in the paper "On Problem..." by V.G. Aleshinsky a formula was proposed for interaction force between current elements. Then he himself substantiates this formula in such a way that its univocality is not proven. He states that "both this formula and Ampere's formula are equally particular cases of a differential of forces... determined to accuracy up to a random vector function... in calculation of ponderomotoric moment the formula... gives no advantage..." and it "like other similar formulas corresponding to current elements cannot be obtained in physical experiments..." My article denies this opinion as my formula was obtained with the use of laws of conservation and, thus, any other formula will contradict the laws of mechanics even in quasistationary cases. The discussed loop-vibrator (dipole) model shows that an electrodynamic formula can be obtained in physical experiments which I also demonstrated in another article under the title "On Possibility of Experimental Test of Longitudinal Interaction Force Presence in Current Elements," *Izvestiya Vuzov SSSR, Elektromekhanika*, 1987, Issue 7.

This also confirms my formulas for interaction between current elements, between moving charges, obtained before 1971 and different from generally admitted ones as well as a number of theoretically discovered effects: superweak DC transformers, mostly on superconductors, which can detect signals without ohmic non-linear elements; principal possibility of negative inductance, etc. At the same time only the proof of existence of a longitudinal component in interaction forces between current elements contradicts relativity theory and, thus, calls to its reconsideration!

Several years ago I turned to Academician V.A. Se-

minozhenko, Member of Parliament and Minister of Science of Ukraine. I asked him to help me get an official evaluation of my works. He is a gifted scientist, and my work did not irritate him as it was with most pundits. He sent my work to some academic institutes and a university. He himself is a physicist, but never dwelt on electrodynamics. And what was the answer of professionals?

The simplest reply came from Chair of Theoretical Nuclear Physics, Faculty of Physical Engineering, Kharkov State University — Chairman Associate Professor Yu.A. Kirochkin, postgraduates Yu.A. Gorobets, I.M. Pamkratov. They repeated old truths of orthodox electrodynamics: “experimental measurement of a field created by a separate DC element is inherently impossible because such element cannot be isolated from the whole conductor whose circuit must be closed. Therefore, we can speak only of the field created by the whole conductor. In *ibis* case there are no contradictions. In case of alternating fields the law of impulse conservation must be treated for the whole closed system consisting of conductors and their fields (the third Newton’s law will be its consequence only in case of constant fields). No difficulties can be seen here.” As we can see from above, this is not true.

To tell the truth, this evaluation was written as early as in 1971 and its authors were so attentive that took formulas of Gauss and Weber and comments of Ya.G. Dorfman for mine! But as to the materials sent by V.P. Seminozhenko more than quarter of the century later, they refused to discuss them because they had already made their evaluation in 1971!

Institute of Electrodynamics, Academy of Science of Ukraine has given multiple evaluations of my works. They have always been contradictory and too primitive. In evaluation of 16.12.1980 signed by Deputy Director A.K. Shidlovsky as to discovery application “The Law of Electrodynamical Interaction” No 32-OT-10089 they admit “the well-known drawbacks of Grassmann formula,” try to disprove my mathematical conclusions and state that “the proposal by V.G. Aleshinsky is not sufficiently substantiated.” This conclusion of Institute of Electrodynamics is the only sensible one, as they try to disprove my notion by way of calculation...

After I proved the conclusions of my opponents to be wrong and submitted a confirmation of my calculation from professional mathematicians, an utterly primitive evaluation by Corresponding Member A.K. Shidlovsky of 30.06.1981 appeared. They simply specified that “for a detailed study of electromagnetic forces one should operate closed currents, but not open-current loop elements. The law of equal action and interaction is thus kept to.” It is a pity that such an honorable person ignores not only electrodynamics, but also history of physics!

And what was the evaluation from the same Institute of Electrodynamics 16 years later when V.P. Semi-

nozhenko sent my materials there? In their evaluation No 6717-441 of 12.11.1997 Prof. Yu.P. Yemets, D.Sc. (Techn.) and Leading Scientist Yu.M. Vasetsky, D.Sc. (Techn.) contradictory to previous paper from the same Institute state that “the laws of electrodynamics never contradict laws of conservation and never lead to any inconsistencies in development and operation of all electric engineering and electric physical devices.” I have shown using my unique calculation models for mental experiment that the official electrodynamics contradicts all laws of conservation! Besides, I showed to my opponents that one cannot consider right such electrodynamics which “never leads to any inconsistencies with practice” during calculation of force acting from closed current upon a moving charge which can easily be tested from its trace, but gives a wrong zero calculated value in calculation offered acting from a moving charge upon a closed current loop or a magnet... This incorrectness is not substantial in practice as the loop or magnet is heavy and the force acting upon them from a single charge or, say, space radiation is infinitesimally small... By the way, oscilloscope ray which does not change with time, unlike space radiation, is a part of a closed loop... But such electrodynamics is primeval as it contradicts the laws of conservation... And besides, one can find systems where such incorrectness can be quite evident... To these undeniable arguments Yemets and Vasetsky answered that “mental experiments are not a sufficient proof for conclusions by V.G. Aleshinsky.” No comment: mental experiments are often basic instruments in consideration of a theory or a law...

And what was the response of Kharkov Institute of Physical Engineering, now called National Center? In 1987 I turned to a known physicist from that institute Yuri Titov, Dr.Sc. (Phys. Math.) and asked to evaluate my works. He agreed but first gave them to his postgraduate Igor Stoletny. The latter was interested, asked many questions till was convinced that I was right. After that he lost any interest and told me so. His tutor also lost interest and became a politician. In 1996 I asked G. Sabelnikov, researcher at National Center of Physical Engineering and assistant of Member of Parliament V.V. Mukhin, to evaluate my works so that I could ask an official evaluation from Institute managers. He approved what he read and began writing his evaluation, but another researcher ran in anger and said that he was an authority in this field and nobody else might dwell on it! I can suppose that this colleague was A.V. Volobuyev.

After that V.P. Seminozhenko sent my materials to National Center of Physical Engineering for evaluation... In official document of 17.06.1997 (UFTI No 80-00/10-1380) signed by A.V. Volobuyev, Dr.Sc. (Phys.-Math.) and Yu.P. Stepanovsky, Cand.Sc. (Phys.Math.) and sent to Academician V.P. Seminozhenko by General Manager, there were 5 mistakes in one formula of impulse of a charged particle interacting to another.

er moving charged particle, the formula being taken from a published book, and two terms with different dimensions were summed — all this can be forgiven... But their statement that “the problem of interactions between moving charges which V.G. Aleshinsky solves has been solved by C. Darwin in 1920” is just a logical folly! Darwin’s formula is identical to electrodynamic formula, then why Darwin? But if his formula is correct whereas electrodynamic formula is wrong, why have scientists not yet acquired Darwin’s formula of interaction force? The matter is that “Darwin’s Lagrangian is substantial in quantum mechanical calculation of multielectronic atoms spectra” (Yu.V. Novozhilov, Yu.A. Yappa, *Electrodynamics*, Moscow, Nauka Publishers, 1978, pp. 214, 215). But if we try to obtain interaction force between moving charges from impulses of two interacting moving charged particles using Darwin’s Lagrangian, it will be even more absurd expression than electrodynamic one... Suffice to say, that according to Darwin’s force formula a vibrator, i.e. a simple TV antenna — direct HF conductor with charges accumulating and disposed at its fringes — must radiate along its axis which is contrary to radio engineering! To get convinced it is not necessary to calculate expression offered by Darwin, enough to take time derivative from Darwin’s impulse as cited by Y.P. Novozhilov or paper by Volobuyev and see to it that in the expression obtained only two terms will depend on charge acceleration, one of them being directed along acceleration and the other along radius vector... Both terms having the same sign, antenna must radiate along its axis, which is contrary to radio engineering! That is why for calculation of interaction forces between moving charges the electrodynamic formula is applied instead of Darwin’s! The UFTI authors either have never seen Darwin’s expression of interaction force or are unable or afraid to calculate it... It is absent in their reference sources either... We must do justice to the authors of evaluation... V.P. Semnozhenko’s assistant told in presence of her boss that “they do not deny that their paper is a complete folly.” I suppose those are words by Yu.P. Stepanovsky who is the best electrodynamic expert in UFTI... At any rate, the next evaluation No 80-00/10-910 of 05.05.1999 is not signed by Stepanovsky... To tell the truth, there are no signatures at all, only covering letter is signed by A.V. Volobuyev as Scientific Secretary...

In a new evaluation from UFTI some amendments have been introduced: in impulse formulas terms with equal dimensions are added, together with Darwin’s impulse formula LaGrange function is cited with a statement that simple differentiation allows to obtain formulas for respective forces... Nevertheless, they do not make this “simple differentiation” and do not say who has made it and where published! They admit that Darwin’s formulas are different from formulas by V.G. Aleshinsky, but keep silence about the question whether Darwin’s formulas match electrodynamic ones

or not: if so, what is the need for Darwin, if not, which of them is wrong? They never answered how Darwin’s formula can be correct if it contradicts radio engineering? They state that “V.G. Aleshinsky’s formula determining the force acting from charge q^2 upon charge q^2 at $\mathbf{V}_2 = 0$ (the second charge stable) come into common Coulomb’s law. But that is not so.”

That, is really not so but this is a property not of Aleshinsky’s formula but of electrodynamic formula which at zero velocity of acting charge becomes Coulomb’s formula! In Aleshinsky’s formula in this case on a par with Coulomb’s force there are some components proportional to square charge velocity acted upon by the force! The authors correctly state that “according to V.G. Aleshinsky... at $\mathbf{V}_1 = \mathbf{V}_2$ force of interaction between charges is always Coulomb’s and does not depend on velocity of charges.” But they are quite wrong when say that “this is contrary to the simple fact of attraction between two parallel currents”! According to Aleshinsky parallel currents will be attracted as moving charges in one conductor interact to stable charges in another one. As moving and stable charges have different signs the forces will provide for attraction of conductors! By the way, according to the electrodynamic formula the force of interaction between charges moving with equal velocities gives only one half of the interaction force between conductors. The other half of force acting says, from the second conductor upon the first one, is given by force acting from the second conductor moving charge upon the first conductor stable charge!

As to statements that relativity theory “has been confirmed in multiple experiments to a great accuracy,” see my discussion in Appendix 1.

When one reads not only wrong, but absolutely senseless, illogical and contrary to common sense evaluations from Ukrainian professionals, he may jump to a conclusion that worse opponents could not be found. But it turned out that it was not so. Some representatives of Israeli science and quasiscientific establishment from among former Soviet citizens were even crueler to me. Thus, Mark Azbel — former *otkaznik* and fighter for human rights, now Professor of Physics at Tel Aviv University, when I turned to him in 1993 with bales of my articles sent me to department of electric engineering having astonished even his colleagues! Compared to such supersmart nonsense even evaluation of Ukrainian opponent’s looks as a top achievement of logic and common sense! The matter is that he, unlike my Ukrainian opponents, knew his abilities, or to be more exact, inabilities, from the very beginning!

Due to my ethnic origin I spent 13 years to obtain higher education, I studied at evening classes of Faculty of Physics at the University, in 1965 they refused to employ me to UFTI as a Jew, but I never saw such hatred of me as in eyes of Yakov Narodetsky! And he is consultant on absorption in science, the man who in

Israel distributes money from Shapir Fund!

He liked to boast how wisely and quite free of charge he proved to an Israeli inventor that his idea to attach a slide rule to a drawer's Kuhlmann was useless! As to my highly fundamental works this former Soviet engineer without a scientific degree stated that Israeli universities would not give evaluations because of lack of funds, he firmly opposed employment of people without degrees at universities and would never give a penny for that! So the man who has achieved what millions of scientists could not get for 200 years is not worth a degree, whereas doctors who cannot decide whether he is right or not justify their degrees?!

A known Dr.Sc. (Phys. Math.), a friend of UFTI Director General, former physicist in Kharkov, and now Professor at Ramat Gan University Friedrich Bass dwelt on electrodynamics for 40 years! Having looked through my materials, this man promised to give his evaluation for 40 minutes, in ten minutes he prolonged the term up to 4 months and then, as I heard, refused of any evaluation at all!

Appendix 3

In newspaper *Trud*-7, Kiev, of 4.11.1999, p. 11, under the column "On the Verge of Fantasy" an article by Moscow *Trud* edition correspondent Sergei Korzennikov from Tomsk was published under the title "Siberian Kolya on a virgin magnetic field," subtitle: "Russian inventors want to benefit their country, but at the time present their works raise interest only abroad."

The newsman wrote: "It is quite true — all genial is simple. Once physicist Gennady Nikolayev from Tomsk who studied electrodynamic problems sawed up a toroidal magnet, turned one of its halves by 180° and made an astonishing discovery: there is a type of magnetic field unknown to science! His Austrian colleague Stefan Marinov, Director of Institute of Fundamental Physics, having learnt of Nikolayev's discovery christened the magnet with biased poles "Siberian Kolya" and equaled Nikolayev to Ampere, Maxwell and other great physicists... This scientific discovery, as its author states, must make a coup in fundamental physics... — Any student, — Nikolayev muses — who dwells on the nature of electromagnetism must earlier or later come to conclusion that science cannot explain some phenomena-taking place in this environment. And it cannot do so because sticks to only one type of magnetic field as studied by Maxwell. I state that on a par with transverse magnetic field a longitudinal one also exists, exerting an action upon currents. Metals remain indifferent to it... A citation from Marinov's book written after having learnt of this discovery: "A cylindrical magnet cut in two by an axial plane with one of the halves turned over creates a magnetic field in the vicinity of cut exerting a longitudinal force action upon

currents... which will help to build a perpetual motion machine: Nikolayev showed me his so called unipolar motor defended by patent... after an initial impulse it can work on energy generated by itself... But it works owing to Nikolayev's magnet in its very center..."

How can we comment on this? An invention belongs to its author even if it was made on the basis of a known physical law. But author of such invention is not author of the discovery. The latter can be only the person who first discovered a new physical law or a new effect contradictory to accepted or non-accepted laws and effects. A discovery can be made either on the basis of experiments by its author himself or on the basis of analysis of known experimental facts and laws of conservation using unique models for mental experiments. But as I have explained in Appendix 2, the laws of interaction between current elements and moving charges containing forces that act along a current element or a moving charge (including current carriers) were discovered by me, not by Nikolayev. And Nikolayev borrowed my first formula from my manuscript submitted to *Tekhnika molodezhi* magazine in 1971. He never denied that, and when in early 1980s he went to Kharkov and met me he admitted that the formula was mine! My manuscripts containing those formulas were sent by me in 1971 and later to Patent Office and multiple magazines... Twice in 1971 and 1979 my discovery applications were rejected at Patent Office... But the laws discovered by me treat not only longitudinal forces in interaction of currents or charges. They also imply a possibility of transformation of even direct current from one loop to another one, even if there is no electric connection between the loops! This is directly stated both in the text of my discovery application and in my published articles... This effect not only has nothing to do with superconductive state of electrodynamics but also is even able to transform current from bifillary loop having no magnetic field into a usual loop!

Molecular currents of a permanent magnet or an electromagnet are currents as well. They can be transformed the same way... The magnet will be degaussed... If in this case energy appears from nothing, the author of such an effect will be Gennady Nikolayev...

In *Radio* magazine, 1984, No 6, pp. 4–5 an interview by correspondent N. Grigoryeva was published with Corresponding Member, Academy of Science of the USSR, V.V. Migulin, who said that "in 1962 British physicist B. Josephson issued his sensational paper for which he obtained Nobel prize later. The sense of effect opened by him was that current could flow between two superconductors divided by a thin dielectric. This current contains a variable whose frequency is closely connected to voltage at this contact, the ratio issuing from laws of quantum mechanics, not of radio engineering. Before that quantum effects had been observed only in microworld, but here they are manifested relative to such macroscopic values as current and field inten-

sity. Naturally, Josephson's discovery raised interest from many specialists... Our works have convinced us that even weak radio wave affecting Josephson's contact cause either a substantial change in current value or deter voltage alteration after change in current. It became clear that using this phenomenon one can detect extremely weak electromagnetic fields, even in UHF range... In 1971 we published a paper where theoretical possibility was expressed of application of Josephson's contact to excite an oscillatory circuit... As our discovery broke some trivial patterns some reviewers were first skeptical to it... It took much time to deny their hesitation and our conclusions were accepted early this year... First in theory and then experimentally we proved that if we connect an oscillatory circuit to Josephson's contact the latter may excite it under certain circumstances... The circuit may be excited at actually any tuned frequency. The essence of that is that Josephson's contact in a certain mode behaves like an inductance, its value varying with time from positive to negative and visa versa. This is quite an unusual effect... Previously physicists issued from the fact that such parameters as inductance may have only positive values. But we proved the possibility of its negative value. This broke or, more exactly, enlarged the existing notions. Besides, we revealed that owing to negative inductance a regeneration of energy in circuit is possible, a new class of UHF amplifiers can appear..."

What can be said of this discovery? First of all, its authors deliberately or indeliberately appropriated the phenomenon of negative inductance opened by me as early as in 1950s! In my manuscript sent to the USSR Academy of Science in 1959 I wrote, "at positive charging of a conductor its inductance will grow. The conductor is being charged negatively, or better another conductor with a stable negative charge placed nearby to avoid an additional charge in current, we shall thus lessen its inductance. If the number of charges carried by current is equal to conductor charge, i.e. when a negative charge moves whereas equal charges, both positive and negative, remain stable, the inductance become zero, but if among stable charges a negative one prevails, the inductance becomes negative... By charging a bifillary wiring we could obtain an inductive element without flux..."

To this material I obtained a negative reply No 4587/97 of 24.11.1959 signed by S.I. Sukhoruchkin, Cand. Of Sc. (Phys.-Math.)

In 1960s my manuscript under the title "On Effect of Conductor Inductive Impedance Dependence of Static Charges" was submitted to *Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki* (No 512, 28.07.1965), *Elektrichestvo* magazine (reply No 953 of 7.06.1966), Soviet Patent Office (No 32-OT-4654, reply to author of 10.09.1965)...

In 1971 my manuscripts describing my new electrodynamics and its laws, where this effect was also speci-

fied, were sent to many periodicals as well as to Patent Office as a discovery application which was even taken for consideration...

Besides, there is a difference between negative inductance by itself and a circuit element acting as negative inductance! If we connect in series a source of AC alternating according to harmonic law, an inductance and a capacitor, then till inductive impedance is more than capacitance impedance the latter will act as a negative inductance. If we substitute the capacitor for an appropriate amplifier it can act as a negative inductance at any frequency, including zero...

Nobody denies the importance of a possibility to detect very weak electric signals or fields, especially in UHF range, even using a Josephson contact demanding a low temperature source. But purely reactive elements of electric circuit cannot generate or amplify oscillations by increase of their power, without alternating or at least on moment appearing active impedance. That is why the authors of the above discovery needed a weakly superconducting environment for parametrical regeneration!

The orthodox electrodynamics prohibited appearance of unipolar induction in a non-alternating circuit; i.e. total time integral of EMF in the circuit per cycle had to be zero. My electrodynamics proved this not to be so.

Moreover, we can show that even application of purely electric systems of special type, but lacking active non-linearity, allows detection of harmonic signals... But in this case output will be many times less than the input... Still, I can propose a system for preamplification of this weak output without any amplifying elements.

It should be noted that the problem of absolute and inabsolute physical prohibition is very acute in thermodynamics. The second law of thermodynamics discovered on the basis of erroneous phlogiston theory but easily proven by modern thermodynamics and statistical physics is treated as one of the basic laws of nature...

However, its statistical substantiation allows questioning its non absoluteness for even a macromass in a closed space... From the other side, the problem of the second law of thermodynamics being absolute or relative is directly connected to the possibility of Universe thermal death and its fate: would it be able to pulsate for infinite time or must die earlier or later... Can, as F. Engels wrote, "heat radiated into space... reconcentrate and begin functioning once more." Modern science possesses some proofs that on a par with trend of growing entropy some anti-entropic dynamic processes exist in Universe. These facts are additional arguments against thermal death of Universe. But this theory cannot yet be completely disproved...

Somebody tried to refute the theory of thermal death by the fact that the second law of thermodynamics is valid only for closed systems whereas Universe is

not such a system. It is not convincing. If Universe is an open system, then it must interact... With what? It is infinite! So it can interact only with itself. But a system that interacts with itself is an isolated system, just of the type where entropy increases. Instead of convincing arguments we have a vicious circle once again. And the somber shade of thermal death... Concentration of matter in space is inevitably accompanied by heat dissipation to environment. The more heat spreads in space the larger is entropy. The second law of thermodynamics states that this growth of entropy is larger than decrease in entropy due to concentration of matter. And nobody has proved the reverse. Well, if any process lead to increase of entropy, than entropy in Universe will become greater and greater until it reaches its maximum, which will mean death...

Yes, gravity counteracts this trend. We can suppose that black holes are just the cauldrons where all types of matter and energy transform to forces of gravity... But how can we test this hypothesis? Black holes absorb together with matter and energy all kinds of information...

So, science cannot disprove the theory of thermal death, which we all dislike so much...

Let us not jump to conclusions. New trends attract attention of scientists to this problem. And they have the last word" (E.A. Sedov, *One Formula and the Whole World*, Moscow, Znanie Publishers, 1982, pp. 120, 137–140).

Using my unique model containing special asymmetric elements and magnetic fields created by unusual magnetic systems, one can show that even in a closed system being in thermodynamic equilibrium state it is possible to perform anti-entropy processes, i.e. transform degenerated heat into work, for instance, into movement of matter macromasses. But this work will be negligibly small under such conditions. Nevertheless, in philosophic plane it says that the second law of thermodynamics is not absolute and Universe would not die thermal death!

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ON SPACETIME DIFFERENTIAL ELEMENTS AND THE DISTRIBUTION OF BIO-HAMILTONIAN COMPONENTS

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Various Hamiltonian models have been derived for chemical structures belonging to living organisms while the Hamiltonian concept was not applied to life as a whole. However, Hamiltonian components were recently defined for living organisms on the condition to take in consideration their evolutionary implications (Bounias, 2001: CASYS'01). This paper identifies differential elements of Spacetime, from which it delimits a probabilistic fuzzy-like invariance standing for conservativity of biological Hamiltonians. The distributions of potential and kinetic components in a individual bio-Hamiltonian, and the distribution of such individual Hamiltonians of living organisms interacting in more complex systems are shown to behave as a non-linear generalized convolution of functions.

Key words: Biological Hamiltonian; Convolution of functions; Spacetime differential; fuzzy-invariance

PACS: 03.65.B2. Foundations, theory of measurements, miscellaneous theories.

Introduction

While living organisms do not behave independently from the properties of matter (Bounias, 1990), for long, no Hamiltonian, nor wave function nor Schrödinger equation was considered for living systems (Rosen, 1989). The concept of a Hamiltonian of a system was originally defined for physical systems in classical and quantum mechanics, then for simple chemical systems. In the recent past years, Hamiltonian treatment has been tried for components of living organisms. Structures were addressed in proteins, for solitons in Raman scattering (Xiao-Feng, 1998) and beta sheet to alpha helix conformations (Ito, 1999), in DNA helix-coil transition (Morozov et al., 2000), in plant light-harvesting chromoprotein complexes (Tretiak et al., 2000). Functions were considered in electron transfer tunneling (Balabin et al., 1998), and energy storage for cellular motion (Nakagawa et al., 2000). All such works have been dealing with Hamiltonian treatment of structures involved in living organisms, that is concerning chemical molecules rather than the living phenomenon in its whole.

However, while Hamiltonian and wave equations are used in Physics to try to predict the evolution of a system, up to the evolution of universe, if similar parameters were to be identified for living organisms, they would contribute to predict the behavior of ecosystems in connection with the status of their embedding medi-

um, namely Planet Earth. The main components of the Hamiltonian of life have recently been shown to include: (i) kinetic components as the manifold $WK = \{WK_m, WK_M, WK_E\}$ of microstructural and metabolic interactions, macroscopic activity and anticipatory behavior leading to homeostatic and evolutionary adaptation; (ii) potential components $WP = \{WP_m, WP_M, WP_E\} \cup (WP_g)$, the latter including the selection of expressed characters from DNA existing structures, and the construction of new genomic components by evolutionary processes (Bounias, 2001).

Since living organisms are interacting in more complex systems and ecosystems, where they are embedded it was necessary to examine by which kind of relations their respective Hamiltonians, which may be only partly conservative, could themselves be connected within more conservative supersystems. This study will address first the distribution of kinetic and potential components of an individual Hamiltonian throughout the time-related sequence of configurations, and then the distribution of interacting Hamiltonians inside a more complex system.

1. On differential elements of spacetime

Former works have demonstrated that our observable spacetime can be formally identified with a ordered

sequence $\{S_i\}$ of 3-D Poincaré sections embedded in a 4-D topological space (Bonaly and Bounias, 1995). Mappings of one into the next section wear the form of a momentum and stand for infinitesimal increments of time and space (Bounias, 1997). The embedding topological 4-space is provided with a natural metrics as the set distance, i.e. the symmetric differences between sets (Bounias and Bonaly, 1996; Bounias, 1997), which is compatible with the definition of a topology on a space. Each section is mapped to the next one by a moment of junction (MJ) which connects either the distances or the objects, i.e. their complementaries or "instans" (Bounias, 1997). In short, space is subdivided into sets intersections, standing for objects (or "instans") denoted by $m < A, B, \dots >$ and their complementaries, i.e. the set distances denoted by $\Delta(A, B, \dots)$.

Definition 1. The Moments of Junction are defined as follows for $G = (m \text{ or } \Delta)$ and $X = \{A, B, \dots\}$:

$$MJ_{G(i,j)} = G_i[X] \perp f_{(i,j)}(X) \quad (1)$$

where function f takes values $0 \leq f_{(i,j)}(X) \leq 1$ (Bounias, 1997), depending on the indicatrix functions $l(x)$ of each point x of a section (S_i) mapped into the topologies of the next (S_{i+1}) , or generally to any further one (S_j) . For any closed and open subparts $P_i(X)$ in (S_i) , one has for any x :

$$l_i(x) = \begin{cases} 1 & \text{iff } x \in (P_i), \\ 0 & \text{iff } x \notin (P_i), \end{cases}$$

then:

$$f_{(i,j)}(x) = \begin{cases} 1 & \text{iff } l_i(x) = l_j(x), \\ 0 & \text{iff } l_i(x) \neq l_j(x). \end{cases} \quad (2)$$

Theorem 1. The Moment of Junction provides a differential element of spacetime.

Proof. Let a space increments from (S_i) to (S_{i+1}) be as small as a difference in one point. Thus, for the mapping of (S_i) into (S_{i+1}) the Moment of Junction $MJ_{(i,i+1)}$ differs by a distance defined by $d(x'_i, x_{i+1})$ where x'_i is the projection of x_i on (S_{i+1}) . Two such points can be adjacent though nonequal, that is the distance $d(x'_i, x_{i+1})$ can be as small as needed, while $MJ_{(i,i+1)}$ remains the same mathematical object. Therefore, $MJ_{(i,i+1)}$ stands for a differential element of space.

Then, as far as there exists at least one point x_i such that $d(x'_i, x_{i+1})$, then $(S) \cap (S) \neq \emptyset$ and the Moment of Junction is positive. Hence, $MJ_{(i,i+1)}$ represents in this case the smallest interval separating two states of the considered space. This interval exists, it is non-null, though it has no measurable duration. This denotes a differential element of time.

Gathered together, these two statements define a differential of both space and time, that is of spacetime, which completes the proof.

2. Interaction mappings of bio-Hamiltonian components

2.1. Distribution of components of individual Hamiltonians

Lemma 2.1.1. The moment of junction of the Hamiltonian of a conservative system is distributive for its components.

Proof. Let W denote the kinetic component and V the potential one in $H = (W + V)$. A variation $(W - dW)$ is accompanied by a correlated $(V + dV)$. In the space-time sequence, $f_{(i,j)}(X_i - dX_i) \mapsto f_{(i,j)}(X_j - dX_i) = f_{(i,j)}(X_j) + f_{(i,j)}(dX_i)$ for objects composing the set X in which W and V can ultimately be measured. Then:

$$\begin{aligned} MJ(W \cup V) &= MJ[(W \setminus dW) \cup (V \cup dV)] \\ &= MJ(W) \cup MJ(V) \cup (dV \setminus dW) \end{aligned}$$

with $(dV \setminus dW) = \emptyset$ iff $dV = dW$.

(Note that the denotation $A \setminus B$ above signifies the complementary of B in A .)

Thus:

$$MJ(W \cup V) = MJ(W) \cup MJ(V)$$

iff the system is conservative.

Lemma 2.1.2. The Hamiltonian of a individual organism is affected a boundary of invariance.

Proof. Let $H(W, V)$ be the Hamiltonian of an organism $A \in (X)$ and φ a function such that: $MJ(W \cup V) = \varphi(MJ\{A\})$. Then, $H(W \cup V) = \varphi(H\{A\})$. Assuming that the system A is measured by continuous variables, the moment MJ of $\varphi(W, V)$ can be written using the joined probability density of W and V , i.e. $f(W, V)$ (Ruegg, 1988):

$$MJ[\varphi(W, V)] = \int \int \varphi(W, V) f(W, V) dW dV \quad (3)$$

Assume the particular case where $\varphi(W, V) = W \cup V$. Then:

$$MJ(W \cup V) = \int \int (W \cup V) f(W, V) dW dV \quad (4)$$

The repartition function of $H = W \cup V$ is $F(h)$, for $H = \{h_1, \dots, h_n\}$ is:

$$F(h) = \int \int_{W \cup V \subseteq h} f(W) f(V) dW dV \quad (5)$$

where h appears as a boundary delimiting the range of invariance of H .

Remarks.

(i) The distribution function $f_{(i,j)}(A)$ is valued in $[0, 1]$ and such is valued the distribution of components giving the measure of W and V . Therefore, the invariance boundary introduces the notion of a fuzzy invariance for the Hamiltonian of a biological organism

whose components are provided a apparent stability by flows of matter and energy from exchanges with the surrounding milieu.

(ii) Function $f_{(i,j)}(A)$ defines the balance of system (A) between W and V forms:

At extrema of global values, $f_{(i,j)}(A) = 1$ denotes a absolutely motionless state ($W=0$) while $f_{(i,j)}(A) = 0$ depicts a state of absolute motion ($V=0$).

2.2. Distributions of Hamiltonian functions for two interacting organisms

Definitions 2.2.1. Denote by $X=\{A,B,Q\}$ the set of species, habitat and resources, respectively. The global ecosystem is a space of magmas [4] $E=\{(X), (\Phi)\}$, where (ϕ) is a functional. Call (O) and (\perp) two kinds of mappings connecting Hamiltonians $H(x_i)$ and $H(x_j)$ for any two members of (X) and (T^\perp) the family of mappings from (\perp) to some (O). Call (φ) the specific kind of relationship which maps two components $H(x_i)$ and $H(x_j)$ contained in $H\{(x_i), (x_j)\}$. Let $H[(x_i) \cup (x_j)] \mapsto \varphi[H(x_i), H(x_j)]$ be a function (approximated as $H(x_i) \cup H(x_j)$ in section 3.1). Note that $dH(x_i) \neq 0$, $dH(x_j) \neq 0$ during interaction, with $dH(x_i, x_j) \approx 0$ for $\varphi(x_i, x_j) \subseteq \{x_i, x_j\} \subseteq (X) \subseteq (E) \subseteq (\text{etc.})$.

Repartition functions still are denoted by F and distribution functions by f .

Theorem 2.2.2. Hamiltonians of individual components of a invariant pair in a system with higher order of complexity are mapped by non-linear convolution-like functions.

Proof. For continued variables, let $H(z) = \varphi H(x_i), H(x_j)$. Then:

$$F(H(z)) = \int_{\varphi(H(x_i), H(x_j)) \subseteq H\{x_i, x_j\}} f(H(x_i), H(x_j)) \times dH(x_i) \cdot dH(x_j), \quad (6)$$

where $H\{x_i, x_j\}$ stands for the former fuzzy invariant boundary h of relation (4).

For discrete variables one would have the following distribution of probabilities:

$$P(\varphi(H(x_i), H(x_j))) = \bigcup_{k \in (\emptyset)}^{k \in (X)} P\{\varphi(H(x_i)) = k\} \cap (\varphi(H(x_j)) = \mathbb{C}_x \varphi(H(x_j))) \quad (7)$$

where $\mathbb{C}_A(B)$ denotes the complementary of B in A, also denoted by $A \setminus B$.

Reducing relations (6) and (7) to the particular case where one would have: $\varphi(H(x_i), H(z)) = (H(x_i) + (x_j))$ would give for a discrete variable:

$$P(H(x_i) + H(x_j)) =$$

$$= \sum_{k=0}^{H_z} \{P(Hx_i = k) \cap (Hx_j = H_z - k)\} \quad (8)$$

and for a continuous variable the repartition function:

$$F(Hz_i) = \int_{-\infty}^{+\infty} f(Hx_i) \cdot F(Hz - Hx_i) dHx_i \quad (9)$$

that is also the distribution, with commutativity between Hx_i and Hx_j :

$$f(Hz_i) = \int_{-\infty}^{+\infty} f(Hx_i) \cdot f(Hz - Hx_i) dHx_i, \quad (10)$$

which denotes the convolution $f(Hx_i) * f(Hx_j)$.

This allows an extension of the general case of the functional (Φ) . In effect: let i and j be indexed on $\text{Card}(X)$, k be indexed on a spatial distribution within any of Poincaré sections (S_α) of the ordered sequence $\{S\}_n$, and L be indexed on the sequence $(n \in L)$. Then, the mappings of (Φ) are involved in the following two expressions:

$$((Hx_i) \perp^L (Hx_j))_{L+t} = T_L^\perp((Hx_i) O^L (Hx_j))_L, \quad (11a)$$

$$((Hx_i) \perp^k (Hx_j))_{k+p} = T_k^\perp((Hx_i) O^k (Hx_j))_k, \quad (11b)$$

that is, by gathering (11a) and (11b) into one single form:

$$\begin{aligned} ((Hx_i) \perp^{L*k} (Hx_j))_{(L+t)*(k+p)} &= \\ &= T_{L*k}^\perp((Hx_i) O^{L*k} (Hx_j))_{L*k}, \end{aligned} \quad (12)$$

which denotes a nonlinear generalized convolution in the sense of Bolivar-Toledo et al. (1985).

(QED)

2.3. Boundaries of the system

Now, some preliminary consideration should be added about the area of validity of the above functionals.

Definitions 2.3.1. We will call "canonic functions" the conditions for the functionality of ecosystems which apply to all members as equivalence relations or in a commutative way (which includes the Abelian groups for all binary relations operating with relevant kinds of mappings). Examples are the founding conditions (Bonaly and Bounias, 2000) of continuity, complementarity and mutualism.

We will call "specific functions" those which connect interspecific relations as order relations. An example is the relation "feeding on" in predator-to-prey relations.

Proposition 2.3.2. The domain of the convolution of Hamiltonians [equation (13)] belongs to the set of canonical functions, and its range belongs to the complete system of canonical plus specific functions.

How specific functions are involved will be matter of further developments.

All these results provide a perspective for further exploration of relationships connecting Hamiltonian components of the Hamiltonian of a global system.

3. Discussion and Conclusion

3.1. Outside components in potential and kinetic energies

The bio-Hamiltonian has been shown to be under influence of external factors, though it represents an internal sum of energy. A potential energy W_P or is the product of a scalar μ (characteristic of components of mass of an object) by a distance of functions $d[\zeta(x_i), \zeta(x_j)]$ of its positions, where ζ maps a causality factor applying on μ . It is noteworthy that E_{Pot} of a system involves the work that forces (i.e. causality components) acting on a system are able to perform, taking into account the parameters of position, shape, configuration, of this system. Thus, components outside the system are involved.

The kinetic energy w_k or E_{kin} is a function of some expression of the mass M of a system ($M = \cup m_i$) and of the square of the velocities $(v_i)^2$ of its components, in a Newtonian, a relativistic and related forms. Importantly, the theorem of the kinetic energy states that the variation of kinetic energy of a system during a time lapse is the sum of all works of all forces (i.e. causality parameters) acting on the system during this interval, thus including internal, external and connection or interaction forces. Since $v_i = dx_i/dt$, the position of objects is again involved.

3.2. Wave function for macroscopic objects

In classical quantum mechanics, the wave function ψ is determined by the frequency ν and by the de Broglie wavelength ($\lambda_{de\ Broglie}$) of a particle (Krasnoholovets, 2001b). So far, no physical interpretation was possible for ψ as the root of a probability of localization. However, recently the wave function of a macroscopic object has alternatively been shown to be conceivable in terms of specific deformations of space, by Krasnoholovets (2001a,b). The period and amplitude of a system composed of a peculiar form of deformation of space (standing for a particle whose mass is proportional to the deformations) periodically com-

municated partly to the surrounding space (giving a "inerton cloud") and then back to the particle. During this cycle, the velocity of a moving particle oscillates between an initial value and zero, and its mass components oscillate between the particle and its inerton cloud (Krasnoholovets, 1997).

This approach provides a physical meaning to the de Broglie and Compton wavelengths as well as to the frequency of the system, and the corresponding formalism has been shown to reach a classical form. Let $\{\pi\}$ be a set of vector parameters describing all of the mass components of the corpuscular system and \hat{c}_π a limit in the velocity of transmission of space deformations; then, $\ddot{\pi} - \hat{c}_\pi^2 \nabla \pi = 0$ (Krasnoholovets, 2002). Wave function components of one particle can thus be extended to those of an entire organism and to all massive objects. Furthermore, the theory consistently allows gravity and relativity to be deduced from submicroscopic properties (Krasnoholovets, 1997, 2000, 2001a). Therefore, a deterministic macroscopic wave function $\psi(X, t)$ becomes conceptually accessible and it can be associated with the Hamiltonian of living organisms. In a preliminary work (Bounias, 2001) it has been pointed out that the trace of the macroscopic wave function of an ecosystem in the sequence $\{S_i\}$ of Poincaré sections stands for the historical of the ecosystem, a non-linear causality factor identified by Landis (1996).

3.3. Specific conservativity status of the bio-Hamiltonian

Studying the Hamiltonian of a living organism rather than just biochemical components raises a property of fuzzy-like conservativity which contrasts with the status of physical objects. However, no physical structure is strictly conservative: the ceaseless motion does not exist, and all corpuscles have limited duration of life. In a molecule, atoms have different Hamiltonians, and the Hamiltonian of the molecule itself is subjected to the nature of interactions with its environment.

In a more complex system like an ecosystem, all components of individual Hamiltonians are interacting in a dynamical steady state. It has been demonstrated (Bounias and Bonaly, 2000) that the state of such an ecosystem is determined by the properties of the orbit of each component (which includes species, habitat and resources) by the manifold of functions. All combinations of these parameters are timely non-linear and the evolution of the system is logically determined by a non-linear convolution: this supports the result obtained here from a more fundamental approach involving the moments of junction as differential elements of spacetime.

The fuzzy-invariance component appearing in biological systems represents a term with topological meaning. In effect, the convolution of bio-Hamiltonians

correlates all their components in a compact space since it is finite and discrete. The Heine-Borel-Lebesgue theorem states that a finite subcover can exist from any finite subcover: the latter is necessarily finite and it involves all possible correlations, of which some actually are reflected in a finite section of spacetime. This lets a choice about which components are selected in a redundant system as Life, and therefore the presence of a fuzzy operator is justified. On the other hand, while the invariance of moments originates in empirical observations, and remains to be formally proved from a completely independent theory, conservativity has been shown to be fulfilled through a continuum of the geometry of physical objects in a 4-manifold, where only their traces in 3-D sections have a physical meaning.

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THE NEW VIEW ON THE NATURE OF BODY'S INERTIA AND LAWS OF NEWTONIAN DYNAMICS

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In this article the authors present the foundations they have developed for non-relativistic dynamics. Contrary to the traditional views but in agreement with experimental data the forces of inertia in this dynamics are regarded as the real forces that act on the bodies moving with absolute acceleration in inertial and non-inertial reference frames. The system of Newton's laws has been subjected to the analysis and supplemented with amendments that improve the agreement of non-relativistic dynamics with experimental data. The second and the third law of Newton in the proposed dynamics are the consequence of the more general laws of dynamics. Like the general theory of relativity, the proposed non-relativistic dynamics, as the authors have shown, estimates correctly the magnitude of the angle of deflection for the light beam passing by the Sun.

1. The inertial forces are real specific forces of mechanical interactions

The laws of Newtonian mechanics that have successfully passed a more than three century test seem to require no changes or improvements. However, when analyzing how well they agree with the experimental data you can find indirect evidence that the known three laws of Newton are only a part of the whole system of non-relativistic classical dynamics necessary and sufficient to describe all macroscopic effects of mechanical interactions.

The analysis has shown that the above drawback in the current dynamics results from that it does not acknowledge, despite the available experimental data, the existence of real forces of inertia. The traditional dynamics does use the forces bearing these names [1-6]. But in fact they all are fictitious inertial forces (pseudoforces) which "work" only in non-inertial reference frames. As a consequence, and we shall show it later, the traditional dynamics is practically incapable to determine correctly all the forces involved in mechanical interactions. And this concerns, without exception, all the mechanical interactions that involve absolute acceleration of bodies since traditional dynamics lacks the laws and forces necessary for this purpose.

For example, if two balls collide they are pressed to each other with the forces

$$\mathbf{F}_{12} = -\mathbf{F}_{21}, \quad (1)$$

Also the balls are deformed and within them elastic

forces due to pressing arise

$$\mathbf{F}_{n12} = -\mathbf{F}_{n21}. \quad (2)$$

Forces (1) and (2), as the experiments evidence, are in agreement with the equality

$$\mathbf{F}_{12} = \mathbf{F}_{n12} = -\mathbf{F}_{21} = -\mathbf{F}_{n21} \quad (3)$$

and meet the requirements of Newton's third law.

It is believed that no other forces except of force (1) and (2) take part in this mechanical interaction. However, the analysis shows that the action of forces (1)-(3) is not enough for the balls' collision to occur exactly in the way it has been observed in the experiments because for these forces to arise in addition to forces (1) acting on the bodies also the external forces acting in the opposite direction should be applied to the balls

$$\mathbf{F}_{e1} = -\mathbf{F}_{21} = -\mathbf{F}_{n1} \quad \text{and} \quad \mathbf{F}_{e2} = -\mathbf{F}_{12} = -\mathbf{F}_{n2}. \quad (4)$$

The experiments show that force \mathbf{F}_{e1} and \mathbf{F}_{e2} are mass forces. The properties of these forces are unusual. The deformation due to pressing as well as the elastic forces that arise, according to (3), in the colliding balls are unambiguous proofs of the action of force \mathbf{F}_{e1} and \mathbf{F}_{e2} on the balls as it follows from (4). But in spite of this it is impossible to identify the bodies whose action on the balls could be associated with the appearance of the above forces. These bodies are some invisible objects unknown to modern science. Forces \mathbf{F}_{e1} and \mathbf{F}_{e2} arise only in case the material points of the balls are accelerated with respect to inertial reference frames but in contrast with ordinary Newton's forces their action is opposed to the balls' absolute accelerations.

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The analysis of the above data shows that forces \mathbf{F}_{e1} and \mathbf{F}_{e2} (4), which make the balls press on each other and cause their deformations in the process of collision can not be Newtonian active forces. Their properties unambiguously prove that they are the forces of inertia. But they are not those fictitious "inertial forces" doubtful from the physical point of view that have been introduced into the traditional dynamics without proper experimental foundation as an artificial mathematical tool for deriving the formula of D'Alembert principle and the equations of relative motion of material point. Forces \mathbf{F}_{e1} and \mathbf{F}_{e2} are real inertial forces that act on the bodies moving with absolute acceleration both in inertial and non-inertial reference frames and the existence of which is completely denied by the traditional dynamics.

The direct action of the force of inertia is its action on the body in which it arises, i.e. on the body that moves with absolute acceleration. But if the inertial force acts via the body in which it arose on the other one in mechanical contact, the force exerted on the latter is the active force due to inertia since it is the measure of intensity with which one body acts on the other. So, the inertial active force \mathbf{F}_{12} appeared as a result of the action of inertial force \mathbf{F}_{e1} on the first ball in which it emerged and the ball acted on the other ball with the force \mathbf{F}_{12} , its magnitude and direction being equal to the inertial force \mathbf{F}_{e1} . These reasons account for the validity of equalities (4) obtained from experimental data.

2. The laws of non-relativistic dynamics

Traditional non-relativistic dynamics is known to be based on four laws, i.e. the laws of Newton and the law of independent action of forces which was in fact also formulated by Newton as the parallelogram rule and later raised to a law. The proposed dynamics adds to the above four two more laws that describe the peculiarities of general action of active and real inertial forces on the material points. And the third law of Newton is an independent law in this dynamics. All the laws of traditional dynamics are valid only in inertial reference frames and are directly applied to material points. But the basic concepts of traditional dynamics, with a few exceptions, are true in the new dynamics as well.

2.1. The first law of dynamics

In Newton's formulation this law reads: "Any body remains at rest or in motion along a straight line unless it is made to change this state by the forces applied to it" [1].

In our considerations about this law the motion due to inertia was conditionally subdivided into completely

and partially inertial motion.

Partially inertial motion can be observed when the material point moves with absolute acceleration. In this way the material point moves in the direction perpendicular to the vector of the resultant of the forces that caused the accelerated motion of this material point. This can be explained by the fact that the projection of the resultant force vector onto the perpendicular plane equals zero.

From the analysis of the peculiarities in the motion of bodies made by the authors the following formulation of the dynamic first law can be made: if no external forces act on the material point moving in some direction or if the resultant force acting on it equals zero, the material point moves in this direction by inertia, i.e. with constant velocity. This formulation embraces all kinds of inertial motion including partially inertial one and does not contradict the fact that only rectilinear uniform motion is completely inertial.

3. The second law of dynamics

3.1. The second in the system of the developed dynamics is the second law of Newton

The second law of Newton has several mathematical embodiments and several respective formulations. One of them states that the absolute acceleration of material point is directly proportional to the active force \mathbf{F} acting on the body and inversely proportional to the inertial mass of the point:

$$\mathbf{a} = \frac{\mathbf{F}}{M}. \quad (5)$$

3.2. The third law of dynamics

The third law of the new dynamics states that the acceleration of material point with respect to the inertial reference frame induces the inertial force arising in the body and acting on it equal to the product of the point's inertial mass by its absolute acceleration taken with the opposite sign; the inertial force causes the inertial acceleration equal by modulo and opposite to the point's absolute acceleration, i.e.

$$\mathbf{F}_e = -M\mathbf{a} = -\mathbf{F} = M\mathbf{a}_e, \quad (6)$$

where \mathbf{F} , \mathbf{F}_e are the active force and inertial force related to it respectively acting on the material point; M , \mathbf{a} and \mathbf{a}_e are inertial mass, absolute and inertial acceleration of the material point.

The traditional dynamics does not apply this law because it denies the existence of real inertial forces and their action in the inertial reference frames. The inertial forces recognized by classical mechanics and general theory of relativity are in fact fictitious inertial forces

that "arise" due to the acceleration of non-inertial reference frames with respect to inertial ones [1-6].

It is obvious that the formula of this law also can be written in terms of momenta:

$$d\mathbf{P}_e = M\mathbf{a}_e dt = -M\mathbf{a} dt = -d\mathbf{P}, \quad (7)$$

where \mathbf{P}_e , \mathbf{P} are inertial and active momenta of the material point.

It is easy to make sure that the real inertial forces exist if we analyze any mechanical interaction in which there is a motion accelerated with respect to the inertial reference frame. We have already demonstrated this in the first section when absolutely elastic collision of balls has been considered. Now we shall prove their existence again from the analysis of rotational motion of the body around motionless vertical axis connected with the body by a flexible thread with a light dynamometer built into the break.

The conventional dynamics states that in the inertial reference frame only centrifugal active force acts on the body [1]

$$\mathbf{F}_c = -Mw^2\mathbf{r}_\perp, \quad (8)$$

which causes the body to move with centrifugal acceleration

$$\mathbf{a}_n = -w^2\mathbf{r}_\perp, \quad (9)$$

where w , \mathbf{r}_\perp are the angular velocity of rotation and radius vector of the body's center of masses directed perpendicularly to the rotation axis.

The experiments give evidence that the centrifugal force is the elastic force arising in the thread due to its stretching by external forces applied to the thread on the both ends. Hence, it unambiguously follows that in the process of rotation the body acts on the thread in the centrifugal direction with the force

$$\mathbf{F}_p = -\mathbf{F}_c = Mw^2\mathbf{r}_\perp, \quad (10)$$

which is equal by its absolute value to centrifugal force (8). However, the body moves with the acceleration in the centrifugal direction and, because of this, according to the laws of conventional dynamics, it can not stretch the thread with force \mathbf{F}_p . Nevertheless the dynamometer shows that force \mathbf{F}_p does act. Therefore there is no other way to solve this paradox except for accepting that the force acting on the body in rotational motion is the inertial centrifugal force

$$\mathbf{F}_e = \mathbf{F}_p = -\mathbf{F}_c = Mw^2\mathbf{r}_\perp, \quad (11)$$

which is like the inertial force in the third law of dynamics (6) is proportional to the absolute acceleration (9) of the body mass center by modulo and directed oppositely to this acceleration. As a consequence, the body,

in its turn, acts on the thread in the centrifugal direction with the force \mathbf{F}_p (10) equal to the inertial force \mathbf{F}_e (11), which is already active force because this is the mechanical action of one body on the other (on the thread).

The new view on the inertial mass can be formulated basing on the laws of the dynamics that has been developed. Its third law (6) allows for a conclusion to be made that the inertial mass of material point equals, as a scalar quantity, the absolute value of the inertial force acting on the point when it moves with respect to the inertial reference frame with acceleration equal to one:

$$M = \frac{|\mathbf{F}_e|}{|(-\mathbf{a})|}. \quad (12)$$

However, in every particular mechanical interaction the inertial mass behaves as a vector quantity because it is the specific force of inertia, i.e. the force of inertia related to the unit of absolute acceleration of material mass. Hence, if the force of inertia does not act on the body moving with acceleration with respect to inertial reference frame the inertial mass of the body is equal to zero.

3.3. The law of independent action of forces

The law of independent action of forces states that in the mechanical interactions the actions of forces on the material points and the effects caused by these actions manifest themselves independently. Therefore this law can be expressed as follows:

$$\mathbf{A}_j = f_j(\mathbf{F}) = \sum_{i=1}^k f_j(\mathbf{F}_i) = \sum_{i=1}^k \mathbf{A}_{ji}, \quad (13)$$

where \mathbf{F} , \mathbf{F}_i are total active force and its constituent forces acting on the material point; \mathbf{A}_j , \mathbf{A}_{ji} are the total effect of j -type and its constituent effect of the action of i -th force; k the number of forces acting on the material point.

The functional dependence f_j between the acting forces and the effects of their action are described by other laws of dynamics.

3.4. The fourth law of dynamics

When developing this law we have made an assumption that the absolute acceleration of material point

$$\mathbf{a} = \mathbf{a}^0 + \mathbf{a}_e, \quad (14)$$

that is determined by the second law of Newton is, in fact, the resultant acceleration of opposite initial \mathbf{a}^0 and inertial \mathbf{a}_e accelerations of the point caused by the independent action of active (Newtonian) force \mathbf{F} and conjugated with its inertial force \mathbf{F}_e respectively.

From the formulas of the third law of dynamics (6) and (7) it is evident that equality (14) is valid only in condition that the absolute value of initial acceleration of the material point is twice as large as both absolute and inertial acceleration,

$$\mathbf{a}^0 = 2\mathbf{a} = -2\mathbf{a}_e. \quad (15)$$

In our opinion these are partial effects of active force and the force of inertia that act simultaneously on the free material point in the inertial reference frame, the addition of which, according to the law of independent action of forces (11), creates the ultimate effect the second law of Newton has described. This Newtonian law determines the resultant acceleration of the material point and the contributions of its components – the initial and inertial accelerations – are taken into account only implicitly. Therefore, if we accept these concepts and (14), the formula of Newton's second law is the consequence of the extended formula of the fourth law in new dynamics according to which the absolute acceleration of the material point

$$\mathbf{a} = \frac{\mathbf{F}}{M^0} + \frac{\mathbf{F}_e}{M_0}, \quad (16)$$

where M_0 is the inertial mass of the material point; \mathbf{F}_e is the force of inertia; M^0 is the proportionality coefficient between the active force \mathbf{F} acting on the material point and the initial acceleration of this point \mathbf{a}^0 . The quantitative value of this coefficient equals a half of normal (not equal to zero) value of inertial M_0 or gravitational M_g mass of the material point, i.e.

$$M^0 = \frac{M_0}{2} = \frac{M_g}{2}. \quad (17)$$

On account of (6) and (7) the extended formula for the fourth law of dynamics can also be written in terms of momenta:

$$\mathbf{a} = \frac{d\mathbf{P}}{M^0 dt} + \frac{d\mathbf{P}_e}{M_0 dt}, \quad (18)$$

here \mathbf{P} , \mathbf{P}_e are active and inertial momenta of the material point.

Formulas (16) and (18) are different from the formula of Newton's second law in that they include the inertial forces as individual terms. As a result the first term in the right hand side of formulas (16) and (18), determines, according to (14), the initial acceleration \mathbf{a}^0 , and the second one – the inertial acceleration \mathbf{a}_e of the material point.

Consequently, according to (16) and (18), the extended form of the dynamics fourth law can be formulated as follows: the absolute acceleration of the material point takes place in the direction of active force action on this point and equals the vector sum of the point's opposite initial acceleration and inertial acceleration, the former being proportional to the active force,

the latter – to the inertial force acting on the point; the proportionality coefficient to the inertial force is the number inverse to the value of point's inertial mass and to the active force it is twice larger.

Applying the extended formula of the fourth law of dynamics to the bodies characterized by inertial mass, and these are all known bodies including most of the elementary particles, we shall obtain the same quantitative results as those obtained by applying the second law of Newton (5).

But if we assumed that there are bodies in nature whose inertial masses are zero, we would obtain, after applying these two laws to them, the results that would not be equivalent. For example, according to the second law of Newton whatever small active force was applied to the body with zero inertial mass this body would acquire indefinitely large acceleration.

In order to determine the absolute acceleration of the material point with zero inertial mass that experiences the action of active force we should assume both the point's inertial mass and inertial force acting on the point to equal zero in the inertial term of formula (16), for example, of the fourth law of dynamics. In the result we shall obtain indeterminate form

$$\frac{\mathbf{F}_e}{M_0} = \frac{0}{0} = 0,$$

since the inertial acceleration of the material point is zero if inertial force does not affect it.

Thus, in the formulas of the fourth law of dynamics (16), (18) the inertial terms are zero for the material points that do not possess inertial mass. If such is a case, we shall come to a conclusion, on account of (14), (15), that according to the fourth law of the new dynamics the acceleration of material point with zero inertial mass under the action of active force is equal to the point's initial acceleration with respect to inertial frame of reference

$$\mathbf{a}^0 = \frac{\mathbf{a}}{M^0} = \frac{d\mathbf{P}}{M^0 dt} = 2\mathbf{a}. \quad (19)$$

As seen from (19) the quantitative estimation of the initial acceleration for material points requires experimenting with the bodies possessing zero inertial mass. The photon, whose inertial mass at rest is known to be exactly zero, belongs to the group of such bodies [6]. When seeking for an opportunity to test the validity of the fourth law of dynamics experimentally for the bodies with zero inertial mass we paid attention to the known experiments that had been carried out to test the prediction of the general theory of relativity concerning the estimation of the angle at which the light beam traveling in a straight line is deflected by the gravitational field of the Sun.

The light beam deflection in the gravitational field is predicted both by Newton's theory of gravitation and Einstein's general theory of relativity. However, only

the latter was proved to be quantitatively correct by the experiments. According to general relativity the largest angle of the deflection of light beam from a remote star is [4,7]

$$\alpha_m = \frac{4GM_c}{c^2 R_c} = 1.75'', \quad (20)$$

where G is the universal gravitational constant; c is the speed of light; M_c and R_c are the gravitational mass and the Sun's radius.

As long ago as in 1801 German geodesist and astronomer Zoldner derived the formula for calculating the angle of light beam deflection by the Sun using Newtonian dynamics

$$a_m = \frac{2GM_c}{c^2 R_c}, \quad (21)$$

Zoldner's formula (21) differs from Einstein's (20) only by proportionality coefficient which is two times smaller [7].

To solve this puzzle, we have analyzed the peculiarities in deriving formula (21). The analysis shows that as the photon moves nearby the Sun it falls in the Sun's gravitational field with absolute acceleration which is twice as large as free-fall acceleration of all other bodies whose inertial and gravitational masses are known to be equal in magnitude. The above experiments showed that such an acceleration of a photon equals the so-called initial acceleration \mathbf{a}^0 (15) with which the material point should move, according to the fourth law of dynamics (19), under the action of active force provided the point's inertial mass is zero.

This characteristic feature distinguishes photons not only from macroscopic bodies but also from elementary particles which possess inertial mass at rest. So, the acceleration of neutrons in the gravitational field of the Earth was found to be 9.6 m/sec^2 , which agrees within the experimental error with the free-fall acceleration for macroscopic bodies [8].

Thus, assuming the photon's inertial mass in the direction perpendicular to tangent velocity of its motion to equal zero and using Newton's law of gravity and the fourth law of the developed dynamics for the bodies with zero inertial mass the formula for determining the angle of deflection for the light beam moving by the Sun. This formula will be analogous to formula (20) that is known to be consistent with the experimental data. We believe that the agreement of the known experiments with the fourth law of dynamics is not accidental. The results of the experiments can be considered the first experimental proves that initial acceleration of bodies (19) predicted by the fourth law of the new dynamics (16) exists in nature. They can be also regarded as indirect indications that photon's inertial mass in the direction perpendicular to its instantaneous velocity equals zero.

3.5. The fifth law of dynamics

In the developed system of dynamic laws the third law of Newton is the fifth. In Newton's formulation this law states: the action is always balanced and opposed by counteraction, or the actions of two bodies on each other are equal and oppositely directed.

At present the formulation of Newton's law is somewhat different: the forces of interaction between two material points are equal by their absolute value, oppositely directed and act along the straight line that connects these material points.

The mathematical formulation of this law is the following

$$\mathbf{F}_{12} = -\mathbf{F}_{21}, \quad (22)$$

where \mathbf{F}_{12} , \mathbf{F}_{21} are active forces with which one body acts on the other and visa versa.

The third law of dynamics in Newton's formulation is completely disengaged from the underlying physical mechanism of the process and does not define neither magnitude nor origin of the acting forces. More detailed formulation of the physical essence of this law for mechanics is given by the proposed dynamics. If two free material points interact mechanically, they make each other move with absolute accelerations opposed to each other that generate inertial forces arising in the points and acting on them by squeezing these points to each other with the forces equal by their absolute value but oppositely directed that equal the product of the points' inertial masses by their absolute accelerations taken with opposite signs. It is obvious that the above essence of the third law of Newton as it is formulated by the new dynamics is not consistent with the traditional dynamics since it denies the existence of real inertial forces and their action on the bodies in inertial reference frames in spite of the evidences provided by the experimental data.

Newton's third law in the new dynamics is not an independent law. It is the consequence of the third and, to less extent, other laws of dynamics. Also Newton's second law is the consequence of more general fourth law of new dynamics. Thus, the number of independent laws in the new dynamics is in fact not larger than in the traditional Newtonian dynamics.

4. The inertia of bodies and fundamental interactions

It is of common knowledge that the indefinite variety of interactions is brought in the end to the action of a small number of fundamental forces, which are the measure of intensity of fundamental interactions occurring in nature. Modern science knows about four such interactions: gravitational, strong, electromagnetic and weak the two latter being united in one

referred to as electrical weak interactions in the novel theories. Hence, there should not be any force in nature that would not belong to any of the fundamental interactions. If we consider the real inertial forces from this point of view we shall make a conclusion that by their properties these forces as well as the inertial active forces generated by their action can not be related to any known fundamental interactions occurring in nature. The inertial mass does not function as a specific charge in any of them. On the basis of the experimental data the conclusion has been drawn that there is some unknown fundamental interaction in nature, which we refer to as inertial one. We use this term for the physical process that occurs in elementary particles moving with absolute acceleration and, therefore in atoms, molecules, microscopic and macroscopic bodies as well, and induces the inertial forces that act on these bodies. The physical nature of this interaction, similarly to all known fundamental interactions, is actually unknown. A hypothesis has been suggested that inertial interaction is going on via specific virtual type inertial radiation generated by hypothetical elementary masses, we referred to as massotrons, in the direction of absolute acceleration. The impulses of the radiation quanta recoil create inertial forces that give rise to the fundamental property of the bodies they have arisen and act in, such as mechanical inertness.

It has been shown that when acting on the bodies simultaneously with the forces of other origin, the forces of inertia create the conditions in which the law of conservation of energy and momentum holds in these interactions. As the experiments evidence the energy can not be transmitted to the body if it perceives the force the other body exerts on it without counteracting this body by force. Hence, if the inertial fundamental interaction did not exist, with its real forces of inertia opposing the action of active forces on the bodies, the laws of conservation of energy and momentum would not hold in mechanical and other fundamental interactions in which the bodies possessing inertial mass acquire absolute acceleration. According to these views the so-called kinetic energy is the potential energy of inertial fundamental interaction.

5. On probability of relation between superfluidity of helium II and inertia of bodies

The proposed dynamics as well as conventional one does not predict the existence of state of matter in which its inert mass is zero but it admits such a possibility in principle while the traditional dynamics does not. According to the third law of new dynamics the bodies that would not have inert mass would be different from ordinary bodies by that they would not experience the action of forces of inertia when moving with absolute

acceleration. Consequently, the momentum and the kinetic energy of the bodies deprived of inert mass would be zero.

In order to search for a substance in the state when its inert mass is zero we can analyze the properties of helium ^4He . This substance is known to undergo phase transition of the second kind characterized by the absence of thermal effect at the temperature $T_\lambda = 2.19$ K. Liquid helium at the temperature above T_λ (He I) does not have the property of ordinary Newtonian liquid. However, when cooled to the temperature below T_λ , helium I is transformed into a liquid with unique properties called helium II (He II) [9]. One of these properties is the so-called superfluidity, i.e. capability to flow without experiencing internal or external friction [9]. The carrier of superfluidity is the so-called superfluid component of helium II appearing in helium I at the temperature below T_λ . The amount of superfluid component increases as the temperature of He II decreases and reaches 98.5% at 1.1 K and 100% at the temperature of absolute zero.

The thermal properties of He II are also unique, such as the capability of superfluid component to flow without transferring heat, the break of continuity on the temperature dependence curve for heat capacity at T_λ , capability of superfluid component to flow spontaneously in the direction of higher temperature, increase of He II temperature in the vessel which superfluid component is leaving and decrease of He II temperature in the vessel into which this component flows, and others [6,9].

The above unusual properties of He II can not be accounted for by using the laws of classical mechanics and thermodynamics. It is believed, that the unique properties of He II are the manifestation of quantum effects at macroscopic level [6]. However, our analysis of He II properties has showed that the unique properties of superfluid phase can be explained if we assume it is consist of atoms with zero inert mass.

The potential possibilities of accepting this hypothesis can be demonstrated by accounting for fluidity and some thermal properties of He II.

The force of internal friction in Newtonian liquids including liquid helium is known from [10] to be equal by modulo to

$$|\mathbf{F}_p| = \frac{6kTS}{D^3n} \left| \frac{dU}{dz} \right|, \quad (23)$$

where k is Boltzman's constant; T and D are the absolute temperature of the liquid and diameter of its molecules; S is the area of the surface of friction; n is the average amount of spontaneous translational molecule replacements in liquid per second; dU/dz the gradient of speed of liquid flow.

As it is evident, the inert mass of the liquid molecules is not included into formula (23). So there is an impres-

sion that the appearance of internal friction in Newtonian liquid does not depend on that whether the molecules possess inert mass or do not. In fact, however, the inert mass is included in formula (23) but only implicitly. This can be proved by substituting the value of absolute temperature into (23) derived from molecular kinetic theory of mono atomic gas [10]

$$T = \frac{M\bar{V}^2}{3kK_e} = \frac{2E}{3kK_e}, \quad (24)$$

where M_a , E and \bar{V}^2 are inert mass, kinetic energy and root-mean-square speed of atom; K_e is the correction factor that compensates the inaccuracy of the formula when applying it to He I.

With the above substitution formula (23) will take the form

$$|\mathbf{F}_p| = \frac{2M_a\bar{V}^2S}{D^3nK_e} \left| \frac{dU}{dz} \right|. \quad (25)$$

Thus, the force of internal friction in Newtonian liquids as well as in gases is proportional to inert mass of molecules in these substances. This indicates that in Newtonian liquids decisive role in formation of internal friction belongs to mechanical interactions between the molecules.

The forces of internal friction arise due to mechanical interactions between molecules. In the process if these interactions the molecules collide as the layers flow with respect to each other and experience opposite absolute accelerations. Due to these accelerations, according to the third law of new dynamics, the real forces of inertia arise in the molecules possessing inert mass and they act in the direction opposite to molecule accelerations. The real forces of inertia act on the molecules in which they arise and via these on the other molecules colliding with them. Being Newtonian forces of inertial origin, these forces represent force of internal friction both in gases and in Newtonian liquids. Moreover, according to the third law of new dynamics (6), the forces of inertia are capable to affect only the bodies that possess inert mass. If only the body does not possess inert mass, the force of inertia can not affect it whatever large may be the absolute acceleration this body moves with. Hence, if inert masses of molecules in Newtonian liquid are zero, the forces of internal friction in this liquid will be also zero according to (25).

Thus, in our view the above evidences are sufficient to draw a conclusion that the transition of a part of liquid helium atoms into the state in which their inert masses are zero is a sufficient condition for a certain amount of such atoms to acquire the property referred to as superfluidity, which is peculiar to superfluid phase of He II. This hypothesis is also sufficient to account for unique thermal properties of He II. If in reality superfluid phase of He II does not possess inert mass, the

absolute temperature of such a phase should be zero according to (24). But the rate of thermal atomic motion for this phase will correspond to higher temperature because the kinetic energy of atoms in such a phase also will be zero. Thus, it follows that heat content of He II superfluid phase that does not possess inert mass will be zero in spite of the fact this phase will be in heat contact with He II normal phase with its temperature above zero. He II phase with such properties cannot be a source of heat energy, so, when moving, it cannot transfer heat and entropy. In general, heat energy can be transferred to superfluid phase with zero inert mass. However, it will not be spent to increase the temperature and heat content of massless phase but will be consumed by the part of atoms moving with the highest speed for their transition into the state with normal inert mass.

The phenomenon of superfluidity is known to be similar in some respects to the phenomenon superconductivity. In view of this fact we have analyzed this similarity by following the hypothesis about the emergence of superconducting state of electric conductors in conditions when the speed of motion and the magnitude of molecule absolute accelerations as well as respective crystal accelerations in the conductor are reduced to the values characteristic of He II atoms at such highest temperature (less than 1.0 to 0.9 K), at which practically the whole amount of He II (except fluctuations He I) consists of superfluid phase. It follows from this hypothesis, and it has already been shown, that the most intensive affect on the increase of temperature of transition into superconducting state is produced by the growth of molecule (crystal) masses of the conductor. The opposite affect is produced by the increase of rigidity of molecular (intercrystallite) bonds. These factors probably make contribution in the formation of the so-called high temperature superconductivity.

To sum up the main concepts of the proposed dynamics considered above we can make a conclusion that it provides better agreement with the experimental data and makes it possible to describe mechanical interactions more specifically than by applying traditional dynamics.

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GENERALIZED NEUTRINO EQUATIONS BY THE SAKURAI-GERSTEN METHOD

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I discuss generalized spin-1/2 massless equations for neutrinos. They have been obtained by Gersten's method for derivation of arbitrary-spin equations. Possible physical consequences are discussed.

1. Introduction

Recently Gersten [1] proposed a method for derivations of massless equations of arbitrary-spin particles. In fact, his method is related to the van der Waerden-Sakurai [2] discussion of obtaining the massive Dirac equation. I commented the derivation of Maxwell equations [1a]¹ in [3] and showed that the method is rather ambiguous because instead of free-space Maxwell equations one can obtain *generalized* $S = 1$ equations, which connect the antisymmetric tensor field with additional scalar fields. The problem of physical significance of additional scalar chi-fields should be solved, of course, by experiment.

In the present article I apply the van der Waerden-Sakurai-Gersten procedure to the spin-1/2 fields. As a result one obtains equations which *generalize* the well-known Weyl equations. However, these equations are known for a long time [4]. Recently, Raspini [5, 6, 7, 8, 9] analyzed them again in detail. I add some comments on physical contents of the generalized spin-1/2 equations.

2. Derivation

I use the equation (4) of the Gersten paper [1a] for two-component spinor wave function:

$$(E^2 - c^2 \vec{p}^2) I^{(2)} \psi = [EI^{(2)} - c \vec{p} \cdot \vec{\sigma}] \cdot [EI^{(2)} + c \vec{p} \cdot \vec{\sigma}] \psi = 0 \quad (\text{eq.(4) of [1a]}). \quad (1)$$

Actually this equation is a massless limit of the equation which has been presented (together with a corresponding method of derivation of the Dirac equation)

in Sakurai book [2]; in the latter case one should substitute $m^2 c^4$ into the right-hand side of eq. (1). However, instead of equation (3.25) of [2] one can define two-component 'right' wave function

$$\phi_R = \frac{1}{m_1 c} (i\hbar \frac{\partial}{\partial x_0} - i\hbar \sigma \cdot \nabla) \psi, \quad \phi_L = \psi \quad (2)$$

with an additional mass parameter m_1 . In such a way we come to the set of equations

$$(i\hbar \frac{\partial}{\partial x_0} + i\hbar \sigma \cdot \nabla) \phi_R = \frac{m_1^2 c}{m_1} \phi_L, \quad (3)$$

$$(i\hbar \frac{\partial}{\partial x_0} - i\hbar \sigma \cdot \nabla) \phi_L = m_1 c \phi_R, \quad (4)$$

which can be written in the 4-component form:

$$\begin{pmatrix} i\hbar(\partial/\partial x_0) & i\hbar \sigma \cdot \nabla \\ -i\hbar \sigma \cdot \nabla & -i\hbar(\partial/\partial x_0) \end{pmatrix} \begin{pmatrix} \psi_A \\ \psi_B \end{pmatrix} = \frac{c}{2} \cdot \begin{pmatrix} (m_1^2/m_1 + m_1) & (-m_1^2/m_1 + m_1) \\ (-m_1^2/m_1 + m_1) & (m_1^2/m_1 + m_1) \end{pmatrix} \begin{pmatrix} \psi_A \\ \psi_B \end{pmatrix} \quad (5)$$

for the function $\Psi = \text{column}(\phi_R + \phi_L \quad \phi_R - \phi_L)$. The equation (5) can be written in the covariant form (as one can see the standard representation of γ^μ matrices was used here):

$$\left[i\gamma^\mu \partial_\mu - \frac{m_1^2 c}{m_1 \hbar} \frac{(1 - \gamma^5)}{2} - \frac{m_1 c}{\hbar} \frac{(1 + \gamma^5)}{2} \right] \Psi = 0. \quad (6)$$

If $m_1 = m_2$ we can recover the standard Dirac equation. As noted in [4b] this procedure can be viewed as simply changing the representation of γ^μ matrices (unless $m_2 \neq 0$).

Furthermore, one can either repeat a similar procedure (the modified Sakurai procedure) starting from

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¹In fact, the $S = 1$ equations.

the ‘massless’ equation (4) of [1a] or put $m_2 = 0$ in eq. (6). The ‘massless equations’ is²

$$\left[i\gamma^\mu \partial_\mu - \frac{m_1 c}{\hbar} \frac{(1 + \gamma^5)}{2} \right] \Psi = 0. \quad (7)$$

Then we may have *physical* difference with the Weyl equation (which is obtained as $m \rightarrow 0$ limit of the usual Dirac equation). The mathematical reason of such a possibility to have *different* massless limits is that the corresponding change of representation of γ^μ matrices involves mass parameters m_1 and m_2 themselves and in a certain limit the corresponding matrix may be non-existent (its elements tend to infinity).

It is interesting that we also can repeat this procedure for the definition (or even more general)

$$\phi_L = \frac{1}{m_3 c} (i\hbar \frac{\partial}{\partial x_0} + i\hbar \sigma \cdot \nabla) \psi, \quad \phi_R = \psi \quad (8)$$

since in the two-component equation the parity properties of the two-component spinor are undefined. The resulting equation is

$$\left[i\gamma^\mu \partial_\mu - \frac{m_4^2 c}{m_3 \hbar} \frac{(1 + \gamma^5)}{2} - \frac{m_3 c}{\hbar} \frac{(1 - \gamma^5)}{2} \right] \tilde{\Psi} = 0, \quad (9)$$

which give us yet another equation in the massless limit ($m_4 \rightarrow 0$):

$$\left[i\gamma^\mu \partial_\mu - \frac{m_3 c}{\hbar} \frac{(1 - \gamma^5)}{2} \right] \tilde{\Psi} = 0, \quad (10)$$

The above procedure can be generalized to *any* Lorentz group representations, *i. e.*, *any* spins. In some sense the equations (7,10) are analogs of the ‘ $S = 1$ equations’ [3, (4-7,10-13)] which also contain additional parameters.

3. Physical Interpretation and the Conclusion

Is the physical content of the generalized $S = 1/2$ ‘massless’ equations the same as that of the Weyl equation? We can answer ‘No’. The excellent discussion can be found in [4a,b]. The theory does *not* have chiral invariance. Those authors call the additional parameters as measures of the degree of chirality. Apart, Tokuoka introduced the concept of the gauge transformations (not to confuse with phase transformations) for the 4-spinor fields. He also found somewhat strange properties of the anti-commutation relations (see §3 in [4a] and cf. [11b]). And, the equation (7) describes *four* states, two of which answer for the positive energy $E = |\mathbf{p}|$, and two others answer for the negative energy $E = -|\mathbf{p}|$.

²It is necessary to stress that the term ‘massless’ is used in the sense that $p_\mu p^\mu = 0$.

We just want to add the following to the discussion. The operator of the *chiral-helicity* $\eta = (\alpha \cdot \hat{\mathbf{p}})$ (in the spinorial representation) used in [4b] (and re-discovered in [11a]) does *not* commute with the Hamiltonian of the equation (7):

$$[\mathcal{H}, \alpha \cdot \hat{\mathbf{p}}]_- = 2 \frac{m_1 c}{\hbar} \frac{1 - \gamma^5}{2} (\gamma \cdot \hat{\mathbf{p}}). \quad (11)$$

For the eigenstates of *chiral-helicity* the set of corresponding equations read ($\eta = \uparrow, \downarrow$)

$$i\gamma^\mu \partial_\mu \Psi_\eta - \frac{m_1 c}{\hbar} \frac{1 + \gamma^5}{2} \Psi_{-\eta} = 0. \quad (12)$$

The conjugated eigenstates of the Hamiltonian $|\Psi_\uparrow + \Psi_\downarrow\rangle$ and $|\Psi_\uparrow - \Psi_\downarrow\rangle$ are connected, in fact, by γ^5 transformation $\Psi \rightarrow \gamma^5 \Psi \sim (\alpha \cdot \hat{\mathbf{p}}) \Psi$ (or $m_1 \rightarrow -m_1$). However, the γ^5 transformation is related to the PT ($t \rightarrow -t$ only) transformation [4b], which, in its turn, can be interpreted as $E \rightarrow -E$, if one accepts Stueckelberg ideas about antiparticles. We associate $|\Psi_\uparrow + \Psi_\downarrow\rangle$ with the positive-energy eigenvalue of the Hamiltonian $E = |\mathbf{p}|$ and $|\Psi_\uparrow - \Psi_\downarrow\rangle$, with the negative-energy eigenvalue of the Hamiltonian ($E = -|\mathbf{p}|$). Thus, the free chiral-helicity massless eigenstates may oscillate one to another with the frequency $\omega = E/\hbar$ (as the massive chiral-helicity eigenstates, see [10a] for details). Moreover, a special kind of interaction which is not symmetric with respect to the chiral-helicity states (for instance, if only left chiral-helicity eigenstates interact with the matter) may induce changes in the oscillation frequency.

It is not yet clear how can these frameworks be connected with the Ryder method of derivation of relativistic wave equations and with subsequent analysis of problems of the choice of normalization and of phase in the papers [10, 11, 12]. However, the conclusion may be similar to that achieved before: the dynamical properties of the massless particles (*e. g.*, neutrinos) may differ from those defined by well-known Weyl and Maxwell equations.

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THE HYDROGEN ATOM — A COMMON POINT OF PARTICLE PHYSICS, COSMOLOGY AND CHEMISTRY

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Based on the background of the model of Expansive Nondecelerative Universe and stemming from a postulate stating that the energy of any particle can be understood as being created by the planckton gravitational energy, deep relationships between the energy parameters of the hydrogen atom (ionisation energy, fine structure constant, hyperfine splitting), mass parameters of its constituents (the proton and electron masses), energy of the elementary quantum of action, the Planck mass, the Z and W bosons masses, and fundamental constants are unveiled. It is suggested that relations coupling also other bosons and leptons properties might be in force.

1. Introduction

Hydrogen is the focus of attention of several scientific disciplines. In its atomic, molecular and ionized forms it dominates in stars and interstellar clouds [1], and hydrogen-related spectra are a fundamental source of information on our Universe. The hydrogen atom (protium) consisting of a proton and an electron has been a touchstone of quantum mechanics and it still belongs to the main objects of particle physics. Chemists perceive the hydrogen atom as a constituent of millions of compounds and as an element with a very reach chemistry.

Scientific disciplines dealing with hydrogen seem to, however, develop as independent branches and it is really a hard task to identify in the scientific literature or textbooks answers to the questions such as:

- are the proton and electron masses independent constants or is there a deeper relationship between them,
- could the parameters of the bearers of fundamental forces (photons, bosons) and the hydrogen atom constituents be mutually connected,
- would it be possible to find any coupling of the hydrogen atom energy parameters and other parameters?

The present paper represents an attempt to offer answers to the above questions. The answers stem from the model of Expansive Nondecelerative Universe (ENU) (its nature is described elsewhere [2]) which has

documented its capability to bridge the problems of microworld and macroworld [3-5].

Here, the ENU model is applied in unveiling relations between the ionisation energy of the hydrogen atom, the energy of hyperfine splitting, and the energy of elementary quantum of action. Moreover, it is evidenced that the proton and electron masses being themselves fundamental constants, can be expressed through the Planck mass, Z and W bosons masses, and other fundamental constants.

2. Theoretical background

The Planck energy E_{Pc}

$$E_{Pc} = m_{Pc} \cdot c^2 = \sqrt{\frac{\hbar \cdot c^5}{G}} = 1.22109 \times 10^{19} \text{ GeV}, \quad (1)$$

where $G(6.67259 \times 10^{-11} \text{ kg}^{-1} \text{ m}^3 \text{ s}^{-2})$ is the gravitational constant and $m_{Pc} (2.176711 \times 10^{-8} \text{ kg})$ is the Planck mass, is of fundamental importance for space structure and existence of the Universe [6]. This energy plays an important role in unifying the fundamental physical interactions.

In our previous work [2] the density of gravitational energy has been expressed by Tolman equation as

$$\varepsilon_g = -\frac{R \cdot c^4}{8\pi \cdot G} \cong -\frac{3m \cdot c^2}{4\pi \cdot a \cdot r^2}, \quad (2)$$

where ε_g is the density of gravitational energy exerted by a body with the mass m at the distance r , R denotes the scalar curvature (contrary to a more frequently used Schwarzschild metric, in the Vaidya metric [7] $R \neq 0$ also outside the body) and a is the gauge factor. The above relation (2) represents an exact expression of the

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energy density in weak fields and, as shown by Virbhadra [8] and us [9], such density is the key component of a pseudotensor describing energy density for strong field conditions.

Our rationalization is based on a postulate stating that the planckton gravitational energy in Compton volume V_C (determined by integration of the gravitational field density of the planckton over Compton volume for any „elementary“ particle) is equal to the rest energy E_0 of that particle. In other words, the particle energy is created by the planckton gravitational energy. This hypothesis can be expressed by relation

$$E_0 = \int |\varepsilon_{g(Pc)}| dV_C \cong m_{Pc} \cdot c^2 \frac{\lambda_C}{a(T)}, \quad (3)$$

in which $a(T)$ is the gauge factor and λ_C is the Compton wavelength. In the above relation (4), λ_C relates to the mass m of a given particle [10]

$$\lambda_C = \frac{\hbar}{m \cdot c} \quad (4)$$

and the gauge factor $a(T)$ relates to the specific time when it held

$$k \cdot T \cong m \cdot c^2, \quad (5)$$

where T is the temperature of the Universe at a given time. Validity of the above mentioned postulate can be justified as follows. In the period starting at the beginning of the Universe expansion and terminating at the end of radiation era it had to hold [6]

$$E \approx T \approx a^{-1/2} \quad (6)$$

or, taking m_{Pc} and l_{Pc} as the initial values, and m and a as the actual ones at a given time,

$$\frac{(m_{Pc} c^2)^2}{(m c^2)^2} = \frac{a}{l_{Pc}}. \quad (7)$$

Taking (8) and (11) into account, relation (12) is obtained

$$a(T) = \frac{m_{Pc}^2 \cdot l_{Pc}}{m^2}, \quad (8)$$

where Planck length l_{Pc} (1.616051×10^{-35} m) is defined as

$$l_{Pc} = \left(\frac{G \cdot \hbar}{c^3} \right)^{1/2}. \quad (9)$$

A substitution of (5) - (14) into (4) leads to the expression

$$E_o = m c^2 \quad (10)$$

that is important for understanding a mutual relation between the gravitational and inertial masses and, what is more significant, proves internal consistency of the used procedure.

3. Results and discussion

This paper is aimed at verifying a more general validity of (4). In case of an effort to find the properties of a particle, Compton volume must be replaced by another volume characteristic for this particle. To evidence the justification of a broader usability of (4), the hydrogen atom was chosen as an example. Its „volume“ expressed through the Bohr radius and composition are known. In addition, its energy parameters (ionization energy, fine structure constant and hyperfine splitting) have been experimentally measured, their values (belonging to the most precisely determined values in the whole physics) are available and this allows to confront the results obtained within our approach with the reality.

To solve the problems associated with verification of (4), it was necessary to determine the gauge factor corresponding to influence of both gravitational and electromagnetic forces. Further, solutions for some different cases are offered.

3.1. Ionization energy of the hydrogen atom

In unification of electromagnetic and weak interactions, Z and W bosons play the crucial role. Gravitational influence of Z and W bosons on their surroundings initiated to manifest itself just when their Compton wavelength became equal to their effective gravitational radius [3, 4]. At that time, gauge factor (denoted here as $a_{I(H)}$) reached the value

$$a_{I(H)} = \frac{\hbar^2}{G \cdot m_{ZW}^3}, \quad (11)$$

where m_{ZW} is the mass of Z and W bosons (a mean mass is taken into account, the actual masses being 1.43361×10^{-25} kg and 1.62557×10^{-25} kg, respectively). Introducing (17) to (4) and substituting Compton wavelength in (4) for the Bohr radius r_H (52.917706 pm) a relation for the hydrogen atom ionization energy I_H is obtained

$$I_H \cong \frac{m_{Pc} \cdot c^2 \cdot r_H \cdot G \cdot m_{ZW}^3}{\hbar^2}. \quad (12)$$

Calculation using numerical values of the right-side members leads to the value of 14.0 eV that is very close to the experimental value 13.6 eV.

3.2. The electron mass

The electron mass m_e belongs to the fundamental constants. In this part it is shown of how this inertial mass depends on other parameters and fundamental constants. The electron mass is a parameter present in expression of both the ionization energy (13) and

Bohr radius (14) of the hydrogen atom [11,12]

$$I_H = \frac{m_e \cdot e^4}{32\pi^2 \cdot \varepsilon_o \cdot \hbar^2} = \frac{\alpha_e^2 \cdot m_e \cdot c^2}{2}; \quad (13)$$

$$r_H = \frac{4\pi \cdot \varepsilon_o \cdot \hbar^2}{m_e \cdot e^2} = \frac{\hbar}{\alpha_e \cdot m_e \cdot c}. \quad (14)$$

In (13) and (14), α_e (7.29735×10^{-3}) is the dimensionless fine structure constant (related to the spin-orbit coupling of the electron), ε_o ($8.854187816 \times 10^{-12} \text{ kg}^{-1} \text{ m}^{-3} \text{ s}^4 \text{ A}^2$) is the vacuum permittivity, m_e ($9.109534 \times 10^{-31} \text{ kg}$) and e ($1.60217733 \times 10^{-19} \text{ A s}$) are the electron mass and charge, respectively. (To be exact, the reduced electron mass should be taken into account, the difference of the masses is, however, customarily omitted). Stemming from (12) – (14), relation (15) correctly expressing the electron mass is obtained

$$m_e = \sqrt{\frac{2m_{ZW}^3}{\alpha_e^3 \cdot m_{Pc}}} = 9.2029 \times 10^{-31} \text{ kg}, \quad (15)$$

which is nearly equal to the actual value. Expressing m_{ZW} as [4]

$$m_{ZW} \cong \sqrt{\frac{\hbar^3}{g_F \cdot c}}, \quad (16)$$

(the Fermi constant $g_F = 1.41 \times 10^{-62} \text{ J} \cdot \text{m}^3$), and its subsequent substitution into (15) allows to express the electron mass through fundamental physical constants only as

$$m_e \cong \sqrt[4]{\frac{4\hbar^9}{\alpha_e^6 \cdot m_{Pc}^2 \cdot g_F^3 \cdot c^3}}. \quad (17)$$

Equation (17) reveals a deep interrelationship between the electron mass (being itself a fundamental constant) and other fundamental constants, and unveils the reason of its value.

3.3. Energy of hyperfine splitting in the hydrogen atom

A further gauge factor (denoted as a_{hf}) is related to the time of initial gravitational influence of proton on its environment. Similarly to (17) it holds (m_p being the proton mass)

$$a_{hf} = \frac{\hbar^2}{G \cdot m_p^3}. \quad (18)$$

Substituting (18) to (4) we obtain

$$E_{hf} \cong \frac{m_{Pc} \cdot c^2 \cdot r_H \cdot G \cdot m_p^3}{\hbar^2}. \quad (19)$$

It must be connected to the energy of hyperfine splitting since this quantity depends on magnetic moments and thus, in turn, on the proton and electron

inertial masses. The electron mass is included in r_H and calculation based on (19) leads to

$$E_{hf} \cong 2.9 \times 10^{-24} \text{ J}. \quad (20)$$

The above value is approximately 3 times higher than the experimentally determined energy of hyperfine splitting. It should be pointed out, however, that the calculation was performed only on the level of first approximation and, moreover, the value in (20) is still more precise than that obtained by means of usually used classical formula (21)

$$E_{hf} \cong \alpha_e^2 \cdot I_H \cdot \frac{m_e}{m_p}. \quad (21)$$

3.4. The proton mass

Using (19) and (21), a simplified relation determining the proton mass emerges

$$m_p \cong \sqrt[4]{\frac{\alpha_e^5 \cdot m_{Pc} \cdot m_e^3}{2}}. \quad (22)$$

In analogy with the electron mass, substituting m_e in (22) for (17) an expression for exhibiting a relationship between the proton mass and fundamental constants emerges offering thus the reason for its value as well as for the ratio of the electron and proton masses.

3.5. Energy of elementary quantum of action

Due to the fact that the energy of gravitational field exerted by an electron to its surroundings is lower than the critical gravitational density, the electron does not exert any detectable gravitational effect on its surroundings at the time being [4]. Gravitational influence of electron will be observable when the gauge factor (denoted here as $a_{g(e)}$) is of the value

$$a_{g(e)} = \frac{\hbar^2}{G \cdot m_e^3}. \quad (23)$$

Substituting (23) into (4) relation describing the energy of elementary quantum of action

$$E_{eq} \cong \frac{m_{Pc} \cdot c^2 \cdot r_H \cdot G \cdot m_e^3}{\hbar^2} \cong 4.8 \times 10^{-34} \text{ J} \quad (24)$$

is obtained. The above value corresponds (and is close at a unit frequency) to the Planck constant h .

4. Conclusions

Utilization of the ENU, as a model enabling to localize the energy of gravitational field, helped to unveil mutual relationships between some fundamental physical constants associated with the hydrogen atom, and to provide correct values of both its energy parameters

and inertial mass of its constituents. The results presented in this contribution clearly documented the applicability of the ENU model in acting as a bridge connecting the macroworld phenomena described by the GTR and the quantum mechanical realm of particles. Verification of the postulate stating that the energy of any particle is created by the planckton gravitational energy using the hydrogen atom as an example, and excellent agreement of the calculated and experimental values of its parameters should be taken as a starting point for further investigation and seeking of interrelationships and common features of the macroworld and microworld phenomena.

It should be noted that a search for relationships between the fundamental forces and constants is becoming a matter of increasing interest of various researchers. Without any comments we would like to bring to the reader attention contributions published recently via ChemWeb [13, 14].

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NEUTRON STAR PROPERTIES VIEWED BY THE ENU MODEL

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Up-to-now known characteristics of radio pulsars, such as mass limits, magnetic field intensity, rotational period, and maximum radiation are mainly of empirical nature. Applying the Expansive Nondecelerative Universe model (ENU) into the issue allows to offer a deeper theoretical explanation of the known parameters and to estimate their limits. Using the ENU approach the following values related to synchrotron radiation emitting radio pulsars were estimated: the lower and upper limits of magnetic field intensity are $B_{P(\min)} \cong 8.5 \times 10^6$ T, and $B_{P(\max)} \cong 4.4 \times 10^9$ T, respectively, the maximum rotation period reaches 3.9 s, the maximum radiation output of a pulsar is $P_{P(rad, \max)} \cong 5.6 \times 10^{29}$ W (all the values relate to radio pulsars with 1.4 solar masses and radius $r = 10^4$ m and are mass and radius dependent). These values are in accordance with the experimental observations.

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1. Introduction

Neutron stars are objects with the mass from about 1.4 (the Chandrasekhar limit) to 3.5 solar masses, diameter $r \cong 10^4$ m, and density 10^{17} kg m⁻³. Spinning neutron stars emitting electromagnetic radiation from their poles are called pulsars. The radiation energy varies from radio waves to gamma rays. Until now investigated neutron stars are characterized [1 - 3] by the magnetic field ranging from 10^7 T to 10^9 T and the rotation period from milliseconds to seconds. Rotating magnetic field influences the electrons being present in the environment, giving thus rise the formation of synchrotron radiation. In addition to "classical" radio pulsars, soft

gamma repeaters - magnetars - with magnetic fields up to 10^{11} T are known, their radiation is not, however, of synchrotron nature caused by electrons. Magnetars are outside the scope of this article.

Radiation output of radio pulsars reaches usually $10^{24} - 10^{28}$ W, with 10^{30} W as a known maximum. The extremely strong gravitational field is able to attract and hold neutrons and electrons within the spheres above iron surface crust up about 1 cm or 10 m, respectively.

2. Neutron star properties

Owing to Vaidya metric application [4], the model of Expansive Nondecelerative Universe [5] enables to localize gravitational energy [6]. Stemming from a general formula [6], the absolute value of gravitational energy density ε_g at a pulsar surface can be expressed as

$$|\varepsilon_g| = \frac{Rc^4}{8\pi G} \cong \frac{3m_P c^2}{4\pi a r_P^2} \cong 4.6 \times 10^{12} \text{ J/m}^3, \quad (1)$$

where R is the scalar curvature ($R \neq 0$ in Vaidya metric [4, 6]), m_P is the pulsar mass, r_P is its radius, and a represents the gauge factor (in the above and following equations the mass 2.8×10^{30} kg, radius 10^4 m, and gauge factor 1.3×10^{26} m were introduced).

It can hardly be a coincidence that the gravitational energy density is very close to (just about 1.4 times higher than) the electromagnetic energy density of hydrogen atom is.

Gravitational field may be described by a wave function [6]

$$\Psi_g = \exp(-i\omega_g t), \quad (2)$$

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where ω_g is the frequency of gravitational wave.

At the pulsar surface

$$\omega_g = \left(\frac{m_P c^5}{\hbar a r_P^2} \right)^{1/4} \cong 1.5 \times 10^{18} \text{ Hz}. \quad (3)$$

Based on the fact that the gravitational field of a pulsar is able to hold electrons up to 10 m distance from the surface it follows that the magnetic moment vector of the electrons shall perform precessional motion with the frequency

$$\omega_e = \frac{B \mu_e}{\hbar} = \frac{B e}{m_e}, \quad (4)$$

where B is the pulsar magnetic field intensity, μ_e is the electron magnetic moment, m_e and e are the electron mass and charge, respectively.

The pulsar stability is preserved only when

$$\omega_g \leq \omega_e. \quad (5)$$

In case of equality (5), stemming from (3) to (5) the lower limit of pulsar magnetic field intensity follows as

$$B_{P(\min)} \cong 8.5 \times 10^6 \text{ T}, \quad (6)$$

which is in excellent accord with the value obtained from experimental observations. The upper limit of pulsar magnetic field intensity can be estimated based on the Compton frequency of electron

$$\omega_C = \frac{m_e c^2}{\hbar} \approx 10^{21} \text{ Hz}, \quad (7)$$

where the limiting condition

$$\omega_e = \omega_C; \quad (8)$$

$$B_{P(\max)} \cong 4.4 \times 10^9 \text{ T}. \quad (9)$$

Of course, the frequency ω_e can approach but never reach the value of ω_C .

As to the structure and composition of neutron stars, various hypotheses have been formulated (from iron-like crust to quark-gluon plasmas). Further we show another mode to derive the value of $B_{P(\max)}$. Suppose, whole pulsar consists of particle with the mass of electron. A number of electrons $n(e)$ corresponding to a pulsar of the mass m_P is then given as

$$n(e) = \frac{m_P}{m_e}. \quad (10)$$

In such a case it can be supposed that the maximum rotation energy of the pulsar is

$$E_{P(\text{rot}, \max)} = \frac{m_P \hbar \omega_{P(\max)}}{m_e} = \frac{m_P \hbar e B_{P(\max)}}{m_e^2}, \quad (11)$$

where $\omega_{P(\max)}$ is a maximum precession motion of the electron magnetic moment vector at the maximum

magnetic field intensity $B_{P(\max)}$. The upper limit of rotational energy of the spherical bodies is expressed as

$$E_{(\text{rot}, \max)} = \frac{m c^2}{5}. \quad (12)$$

Putting (11) and (12) identical, it leads to

$$B_{P(\max)} \cong 6.7 \times 10^8 \text{ T}, \quad (13)$$

which is the value being in good agreement with expectations. It can be stated that there is no possibility to find a pulsar of a 1.4 solar masses having its magnetic field intensity higher than that given by (9) or (13).

The lower limit of pulsar rotational energy emerges when the electron mass in (11) is substituted for the neutron mass m_n and the minimum value of the magnetic field intensity $B_{P(\min)}$ given by (6) is introduced. In such a case,

$$\frac{m_P \hbar e B_{P(\min)}}{m_n^2} = \frac{m_P r_P^2 \omega_{(\min)}^2}{5}. \quad (14)$$

The maximum rotation period of a neutron star following from (14) is then

$$t_{(\text{rot}, \max)} = \frac{2\pi}{\omega_{(\min)}} \cong 3.9 \text{ s}. \quad (15)$$

Also this value is in excellent agreement with observation. At present, the maximum rotational period of 3.8 s is reported, it should be pointed out, however, that 1) the rotational period is mass and radius dependent, 2) it can change due to energy emission, 3) it can change due to mass transfer when existing in binaries. Longer rotational periods are usually ascribed to white dwarfs.

The ENU approach enable to evaluate the radiation output of pulsars $P_{P(\text{rad})}$. In order to secure a pulsar stability, its radiation output cannot exceed its gravitational output $P_{P(g)}$, i.e.

$$P_{P(g)} \geq P_{P(\text{rad})}. \quad (16)$$

In the ENU model, generally [6]

$$|P_g| = \frac{d}{dt} \int \frac{R c^4}{8\pi G} dV = \frac{m c^3}{a}. \quad (17)$$

Comparing eqs. (16) and (17) it follows that any pulsar formed from a star with the Chandrasekhar limit mass and radius $r \cong 10^4 \text{ m}$ cannot have radiation output higher than

$$P_{P(\text{rad}, \max)} \cong 5.6 \times 10^{29} \text{ W}, \quad (18)$$

which corresponds to the observed values.

3. Conclusions

Up-to-now known values of pulsar magnetic field intensity, rotational period, and maximum radiation output stem from experimental observation and are of empirical nature. Applying the ENU model into the matter allows to offer a deeper theoretical explanation of the known values and to estimate the limits for the mentioned parameters.

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ON STRING COSMOLOGY AND DE SITTER INFLATION WITH MASSLESS DILATONS AND DYNAMICAL TORSION

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Variation of the 4 – D string cosmology action with dynamical torsion and massless dilatons lead to an expression of torsion in terms of massless dilatons in the case of de Sitter inflation. The solution is approximated according to the COBE data.

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Recently a renewed interest in cosmology with spin and torsion has arisen in the context of inflationary cosmology with the independent investigation by Palle [1] and myself [2] of density fluctuations in Einstein-Cartan cosmology by making use of cosmic background radiation from the COBE data [3]. Earlier also Maroto and Shapiro [4] have computed the stability of string higher-order gravity cosmology de Sitter solution with dilatons. In their paper they consider a non-dynamical torsion solution where in particular a constant torsion may play the role of a cosmological constant. In this note we show that the relaxation of the constraint of a non-dynamical torsion may lead to some interesting physical consequences, such as the dependence of torsion with the massless dilaton potential. It may also contribute to a better understanding of the role played by torsion on the inflationary process. We start from a Friedmann metric

$$ds^2 = dt^2 - a(t)^2(dx^2 + dy^2 + dz^2), \quad (1)$$

where the action is given by

$$S = \int dt e^{3b} e^{-2\phi} L(T, \dot{T}, \dot{\phi}). \quad (2)$$

Where $b = \log a(t)$. Variation of this action with respect to the dilaton field ϕ leads to the following Euler-Lagrange equation

$$\frac{d}{dt} \left(\frac{\partial e^{3b} e^{-2\phi} L}{\partial \dot{\phi}} \right) - \frac{\partial L}{\partial \phi} = 0. \quad (3)$$

Expansion of the first term of this last equation leads to the expression

$$-2\phi L + \frac{\partial L}{\partial \phi} (3H - 2\dot{\phi}) + \frac{d}{dt} \frac{\partial L}{\partial \dot{\phi}} = 0. \quad (4)$$

Where $H(t) = \frac{\dot{a}(t)}{a}$. By making use of the following Lagrangean

$$L = R + \dot{T} + T^2 - \dot{\phi}^2, \quad (5)$$

which represents the Lagrangean for a 4-D string cosmology with massless dilatons and dynamical torsion. Solution of expression (5) into expression (4) leads to

$$-6H\dot{\phi} - 4\dot{\phi}^2 - 2\ddot{\phi} + 2\phi[-12H_0^2 + \dot{T} + T^2 - \dot{\phi}^2] = 0 \quad (6)$$

by making use of the approximation that $H^2 \ll \dot{\phi}^2$ which is consistent with the matter density fluctuation $\frac{\delta\rho}{\rho} = \frac{H^2}{\dot{\phi}} \ll \ll 1$ which is consistent with the COBE data, and considering that the variation of torsion is not much less than the variation of dilaton potential although torsion is indeed much weaker than the dilaton potential we obtained the following approximation consistent with the observations

$$T(t) = \phi(t) + 3H_0 \log \phi, \quad (7)$$

which reveals the behaviour of torsion in terms of a massless dilaton during the inflationary de Sitter phase. Expansion of this expression with time reads

$$T(t) = a_0 t + b_0 t^2 + 3H_0 \phi + H_0 c_0 \phi^2 + \dots \quad (8)$$

And torsion seems to act as a energy of the vacuum with massive terms ϕ^2 although we are dealing with massless dilatons.

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GROWTH AND DECAY OF INHOMOGENEITIES IN NEWTONIAN COSMOLOGY: SPIN EFFECTS

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The growing and decaying modes of inhomogeneities in Newtonian cosmology caused by small perturbations and its spin effects are investigated in detail in the realm of Newtonian Cosmology. As an example we consider the Einstein-de Sitter cosmological model with spin corrections and the instability of the Einstein static model with spin density.

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1. Introduction

Fluctuations on spin in cosmology [1] may appear mainly in two forms: The first is on quantum spin fluctuations [2] in Einstein-Cartan cosmology which creates some problems to Higgs mechanism and the second which is connected with the spin as the angular momentum of galaxies and stars. Both may be considered in the context of Einstein-Cartan spinning fluids [3, 4]. Einstein-Cartan gravity may be used to give an explanation on the origin of angular momentum of Galaxies [5]. Nevertheless to handle with some astronomical problems we do not need to make use of relativistic cosmology, either General-Relativity nor other kind of alternative cosmology [6]. In this letter we shall make use of the Newtonian cosmological fluids with spin density. The only difference from the usual hydrodynamical approach of cosmological perturbations in Newtonian cosmology is that we make use of Poisson's equation of Newtonian gravity with a small second order correction due to spin density effects. Fluctuations on the spin density will appear as a source of the evolution equation as cosmological density perturbations, spin effects on small cosmological perturbations on General Relativity (GR) spinning fluids have been investigated by Yu N.Obukhov and O.Piskareva [7].

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2. Newtonian hydrodynamics perturbations in cosmology: spin density effects.

In this section we derive the evolution equation of density perturbations in Newtonian cosmology with a correction term due spin density into Poisson's equation of the quasi-Newtonian gravitational field ϕ . The Poisson equation is given by [3].

$$\nabla^2 \phi_0 = 4\pi G(\rho_0 - G\sigma_0^2), \quad (1)$$

where ρ is the matter density while $\sigma^2 \equiv \langle S_{ijk} S^{ijk} \rangle$ where S_{ijk} is the spin density tensor ($i, j = 0, 1, 2, 3$). The evolution equation of density contrast $\Delta = \frac{\delta\rho}{\rho}$ where $\rho = \rho_0 + \delta\rho$ where ρ_0 is the background density of the Newtonian cosmological model. The unperturbed solutions for velocity \vec{v}_0 , density ρ_0 , pressure p_0 and gravitational potential ϕ_0 in:

$$\begin{aligned} \frac{d}{dt}\rho_0 &= -\rho_0 \nabla \cdot \vec{v}_0; \\ \frac{d}{dt}\vec{v}_0 &= -\frac{1}{\rho_0} \nabla p_0 - \nabla \phi_0 \end{aligned} \quad (2)$$

along with equation (1) the background hydrodynamical equations. First order perturbations of the hydro-

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dynamical quantities are

$$\begin{aligned}\vec{v} &= \vec{v}_0 + \delta\vec{v}; \\ p &= p_0 + \delta p; \\ \phi &= \phi_0 + \delta\phi; \\ \sigma^2 &= \sigma_0^2 + \delta\sigma^2\end{aligned}\quad (3)$$

following the same usual steps of deriving the evolution equations (9) one obtains

$$\frac{d}{dt}\left(\frac{\delta\rho}{\rho_0}\right) = \frac{d\Delta}{dt} = -\nabla \cdot \delta\vec{v} \quad (4)$$

and after some algebra one obtains

$$\frac{d}{dt}(\delta\vec{v}) + (\delta\vec{v} \cdot \nabla)\vec{v}_0 = -\frac{1}{\rho_0} \nabla \delta\rho - \nabla \delta\phi. \quad (5)$$

The perturbation of Poisson's equation is

$$\nabla^2 \delta\phi = 4\pi G(\delta\rho - G\delta\sigma^2). \quad (6)$$

Since in cosmology, the background is expanding uniformly it is convenient to use comoving coordinates by writing in the usual way $\vec{x} = R(t)\vec{r}$ where \vec{r} is the comoving coordinate distance and $R(t)$ is the cosmic scale factor. Thus one obtains

$$\delta\vec{x} = \delta[R(t)\vec{r}] = \vec{r}\delta R + R(t)\delta\vec{r} \quad (7)$$

and its corresponding velocity is

$$\vec{v} = \frac{\delta\vec{x}}{\delta t} = \frac{dR}{dt}\vec{r} + R(t)\frac{d\vec{r}}{dt}, \quad (8)$$

therefore

$$\frac{d}{dt}(R\vec{u}) + (R\vec{u} \cdot \nabla)\dot{R}\vec{r}_0 = -\frac{1}{\rho_0}\nabla\delta p - \nabla\delta\phi, \quad (9)$$

where the differential operator is given by

$$\frac{d}{dx} = \frac{1}{R} \frac{d}{dr} \quad (10)$$

along with the relation

$$(R\vec{u} \cdot \nabla)\dot{R}\vec{r} = \vec{u}\dot{R} \quad (11)$$

equation (10) becomes

$$\frac{d\vec{u}}{dt} + 2\left(\frac{\dot{R}}{R}\right)\vec{u} = -\frac{1}{\rho_0 R^2}\nabla_c \delta p - \frac{1}{R^2}\nabla_c \delta\phi. \quad (12)$$

From this point onwards we just consider dust perturbations, where the pressure p vanishes therefore

$$\nabla_c \dot{\vec{u}} + 2\left(\frac{\dot{R}}{R}\right)\nabla_c \vec{u} = -\frac{1}{R^2}\nabla_c^2(\delta\phi); \quad (13)$$

and

$$\frac{d^2}{dt^2}\left(\frac{\delta\rho}{\rho}\right) = -\nabla_c \dot{\vec{u}}. \quad (14)$$

Thus substitution of (14) into (13) yields

$$\frac{d^2\Delta}{dt^2} + 2\left(\frac{\dot{R}}{R}\right)\frac{d\Delta}{dt} = 4\pi G(\delta\rho - G\delta\sigma^2), \quad (15)$$

where use has been made of the modified Poisson equation (1) to account for spin effects. Seeking for wave solutions of this equation of the type

$$\Delta \propto \exp[i(\vec{k}_c \cdot \vec{r} - \omega t)] \quad (16)$$

we obtain the wave equation for density contrast Δ as

$$\frac{d^2\Delta}{dt^2} + 2\left(\frac{\dot{R}}{R}\right)\frac{d\Delta}{dt} = 4\pi G(\rho_0\Delta - \sigma_0^2\Delta_s), \quad (17)$$

where by definition $\Delta_s \equiv \frac{\delta\sigma^2}{\sigma_0^2}$ is the spin-density contrast or spin fluctuation. To better notice the spin effects on the perturbation wave equation in the next section we to solve this equation in the particular case where the background model is the Einstein-de Sitter cosmological model.

3. Einstein-de Sitter model and spin fluctuations

In this section we assume that the background model is the Einstein-de Sitter model where

$$\frac{\dot{R}}{R} = \frac{2}{3t} \quad (18)$$

and

$$4\pi G\rho_0 = \frac{2}{3t^2}. \quad (19)$$

Substitution of (18) and (19) into (17) yields

$$\frac{d^2\Delta}{dt^2} + \frac{4}{3t}\frac{d\Delta}{dt} - \frac{2\Delta}{3t^2} = -4\pi G\sigma_0^2\Delta_s. \quad (20)$$

In this equation we see Δ_s clearly that the spin density contrast is the source for the matter density contrast Δ .

A simple solution of equation (20) can be obtained from the conservation equation of spin density

$$\frac{d}{dt}\delta\sigma^2 = -6\frac{\dot{R}}{R}\delta\sigma^2 \quad (21)$$

which solution is

$$\delta\sigma^2 = \frac{S_0^2}{R^6}, \quad (22)$$

where in (22) the spin constant S_0^2 is considered very small, otherwise $\delta\sigma^2$ would not be a small perturbation. Since in Einstein-de Sitter cosmology $R = (\frac{3}{2}H_0 t)^{\frac{2}{3}}$ one obtains

$$\frac{d^2\Delta}{dt^2} + \frac{4}{3t}\frac{d\Delta}{dt} - \frac{2\Delta}{3t^2} = -4\frac{\pi G\sigma_0^2}{H_0^4 t^4}. \quad (23)$$

Notice that when the spin density vanishes the solution reduces to the General Relativity (GR) solution

$$\Delta_{GR} = c_1 t^{\frac{2}{3}} + c_2 t^{-1} \quad (24)$$

which exhibits a growing mode solution $\Delta_+ \propto t^{\frac{2}{3}}$ and a decaying mode $\Delta_- \propto t^{-1}$. When the complete solution is search one obtain

$$\Delta_{EC} = \Delta_{GR} + c_3 t^{-2}, \quad (25)$$

where c_1, c_2 and c_3 are integration constants. We note that spin effects rapidly decay with the expansion of the universe which makes the spin effects on inflation, for example, extremely weak!. Note also that torsion redshift away in cosmological inflationary scenarios.

4. The instability of Einstein Static cosmological model with spin density.

Note that in the case of the Einstein static cosmological model $\frac{\dot{R}}{R}$ would vanishes which reduces the evolution equation to

$$\frac{d^2 \Delta}{dt^2} = 4\pi G(\rho_0 \Delta - \sigma_0^2 \Delta_s) \quad (26)$$

or

$$\frac{d^2 \Delta}{dt^2} - 4\pi G \rho_0 \Delta = -4\pi G \sigma_0^2 \Delta_s \quad (27)$$

which solves to

$$\Delta = \exp(+t\sqrt{4\pi G \rho_0}) + \left(\frac{\sigma_0^2}{\rho_0}\right) \Delta_s. \quad (28)$$

if the spin density contrast Δ_s is constant.

Thus from expression (28) we note that the Einstein universe is unstable as $t \rightarrow \infty$ and the spin density contrast Δ_s would not contribute to its stability. Indeed it can be proved from the spin density conservation equation

$$\frac{d\delta\sigma^2}{dt} = -6\frac{\dot{R}}{R}\delta\sigma^2 = 0 \quad (29)$$

for the Einstein static model which implies:

$$\Delta_s \equiv \frac{\delta\sigma^2}{\sigma_0^2} = const. \quad (30)$$

Since the same equation (29) can be written to σ_0^2 . The instability of Einstein Static model without spin density was already been showed by Arthur Eddington in 1935. Future prospects in our research include to investigate perturbations in cosmological models with uncoupled matter, radiation and mader spin torsion fluctuations.

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TORSION GRAVITATION AHARONOV-BOHM EFFECT

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Torsion gravitational contribution to the Aharonov-Bohm (A-B) effects is estimated. Phase difference between two beams of electrons is shown to be torsion dependent. It is possible to place limits on torsion by measuring the A-B phase. Torsion contributions to A-B phase on the earth experiments is computed. Due to the very small torsion field on the surface of the earth $Q_* \cong 10^{-24} s^{-1}$ this is a very small effect. Never theless a "gedanken" A-B experiment performed on the surface of a rotating neutron Star ($Q_{NS} \cong 10 s^{-1}$) would lead to an appreciable phase shift in quantum interference experiments.

1. Torsion Detection Physics and the A-B Effect

Earlier Aharonov and D. Bohm[1] showed that when two electron beams are circulated on opposite sides of a solenoid, a phase difference develops between them, which is proportional to the total flux enclosed by the solenoid. Thus

$$\Delta\theta \cong \exp \oint_c \vec{A} \cdot d\vec{l} = \exp \int \int \vec{B} \cdot d\vec{S} = \exp(2\pi i\phi). \quad (1)$$

The A-B phase depends only on the total flux enclosed.

The 3-form torsion field strenght can be expressed as the curl of a 2-form potential[2]

$$H = dB, \quad \phi = \frac{1}{2\pi} \int_{\Omega} H = \frac{1}{2\pi} \int_{\Sigma} B. \quad (2)$$

Where \sum is the borendary of Ω . The equivalent A-B phase ϕ is given by

$$\exp \left(i \int_{\Sigma} B \right) = \exp(2\pi i\phi). \quad (3)$$

For instance the world sheet of a torsion induced String[3, 4] lies on a closed surface \sum where the defect carries a flux ϕ then $\Delta\theta$ would give the phase acquired by the defect. This is similar to the A-B interaction of a magnetic solenoid with an electric charged particle.

$$\Delta\theta_{A-B} = \exp \left(\int \int \frac{8\pi}{3c} (2\alpha G)^{1/2} \frac{c^2 Q}{4\pi G} dS \right) = \Delta\theta_{(A-B)T} \quad (4)$$

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that is

$$\Delta\theta = \exp \int \int \left(\frac{8}{9} \frac{\alpha c^2}{cr} \right)^{1/2} Q dS. \quad (5)$$

Where $\alpha \cong \frac{e^2}{\hbar c} = \frac{1}{137}$ is the fine structure electromagnetic constant and Q is the torsion 1-form which is related to the spin density σ of Einstein-Cartan theory as

$$Q = \frac{4\pi G}{c^2} \sigma. \quad (6)$$

This comes into play because the torsion induces a magnetic field B through the relation

$$B = \left(\frac{8\pi}{3c} \right) (2\alpha G)^{1/2} \sigma. \quad (7)$$

We can give a rough numerical estimate. Suppose we have a $1cm^3$ ferromagnetic substance with $\cong 10^{22}$ nuclei aligned then $\sigma \cong N_A \hbar$, where N_A is the Avogadro number. This gives a fractional correction to the flux as

$$\frac{\delta\phi_T}{\phi_T} \cong 10^{-18}. \quad (8)$$

Where we have used the formula connecting the torsion and the magnetic field it induces through the relation

$$Q = \left(\frac{9G}{8\alpha c^2} \right)^{1/2} B. \quad (9)$$

Moreover any magnetic field could give rise to torsion through the above relation. This would also give rise to a correction to the total flux of

$$\int \int \left(\frac{9G}{8\alpha c^2} \right)^{1/2} B dS = \Delta\phi_T. \quad (10)$$

Since the observable A-B phase depends only on the total flux as

$$\Delta\theta_{\alpha\exp} \left(\int \int B dS \right). \quad (11)$$

The Torsion correction to the A-B phase for a given magnetic field B enclose by the path is

$$\begin{aligned} \Delta\theta_{TG} &\cong \exp(\Delta\phi_{TG}) = \\ &= \exp \left(\int \int \left(\frac{9G}{8\alpha c^2} \right)^{1/2} B dS \right). \end{aligned} \quad (12)$$

For a field 1 Gauss (approximatively the magnetic field of the earth), this would give a correction of $\cong 10^{-13} \text{ Gauss}$, only about one or two orders of magnitude below the current superconducting Quantum Interference Device (SQUID) capabilities which are $\cong 10^{-12} \text{ Gauss}$. To compare the Torsion Gravity contribution to Torsionless Gravity effects on the A-B experiment we use the result of Huei Peng[5] on the Gravitomagnetic (GM) influence on the A-B phase which is given by

$$\Delta\phi_{GM} \cong \frac{4m}{\hbar} \int \int \vec{B}_g \cdot d\vec{S} = \frac{4Gm\pi^2 R^4 \rho W}{\hbar c^2}. \quad (13)$$

Where B_g is the GM field.

Which for a stationary rotating cylinder of $R \cong 1.8 \text{ cm}$ yields $\Delta\phi_{GM} \cong 10^{-21}$ for electron and $\cong 10^{-18}$ for neutrons. In the case of TG the corresponding result is

$$\Delta\phi_{TG} \cong \left(\frac{9G}{8\alpha c^2} \right)^{1/2} \int \int B \cdot dS = 10^{-13} \quad (14)$$

for electrons and B_r 1 Gauss. Thus we conclude that there is an improvement of eight order of magnitude from the previous result obtained from GM. Unfortunately this order of magnitude is still far beyond the present-day capabilities of our devices. For example in the case of neutron interferometer in spaces with Torsion considered by Anandan and Lesche they argue that an accuracy of 10^{-3} in the for A-B phase would lead to a Torsion of the order of 10^{-9} cm^{-1} . In our case to obtain such a precision would lead to

$$\Delta\phi_{TG} \cong 10^{-3} = \int \int Q dS \Rightarrow \quad (15)$$

and from (15) a Torsion field of $Q \cong 10^{-3} \text{ cm}$ would be needed. This expression represents a Topological Defect. Unfortunately such a Torsion field is too strong. To give an idea inside neutron star[8] Torsion fields of the order of 10^{-19} cm^{-1} can be found. Some years ago Nitsch and Hehl[11] has pointed out that the Torsion field the earth's surface would be $Q_* \cong 10^{-24} \text{ s}^{-1}$ and latter Zhang showed that the Torsion field of the Pulsar $Q_{NS} \cong 10 \text{ s}^{-1}$.

2. Rotational and Torsion Effects from the Earth and Pulsars

Considering as before a cylinder of $R \cong 1.8 \text{ cm}$, $A \cong 10 \text{ cm}^2$ and the phase shift on the earth ($Q_* \cong 10^{-24} \text{ s}^{-1}$) is $(\Delta\phi)_* \cong 10^{-24}$. This result is very small to be measurable for present-day experimental sensitivity. Nevertheless in the case where the source of Torsion Gravity is a rotating neutron star[8] $Q_{NS} \cong 10 \text{ s}^{-1}$ and the phase shift is $(\Delta\phi)_{NS} \cong 10$ which is a considerable improvement compared with the same experiment performed on the surface of the earth. More recently V. de Sabbata, P. Pronin and C. Sivaram have on Neutron interferometer using a Gauge Gravity with Torsion. Considering the well known fact that[10] $Q = \hbar c n$ where n is the number of polarized neutron density.

They placed a limit of $Q_n \cong 10^{-17} n$ on Torsion. In some experiments with slow neutrons we have a beam of about $2 \times 10^2 \text{ neutrons/minute}$ which yield $Q_n \cong 10^{-16} \text{ s}^{-1}$ which is considerably stronger than the Torsion field of the earth but much weaker than the Torsion field of a Neutron Star. These facts may contribute to Torsion Detection Physics theory[6].

Making use of result by Anandan[7] for the Spin Gravity and rotational effects[12, 13] of the earth on a Quantum Interference Experiment with neutrons

$$\Delta\phi = \frac{2W}{c} \Omega A. \quad (16)$$

Where A is the area enclosed by the beams, W is the Planck-Einstein frequency $\frac{W}{c} \cong m_{Ac}$ for slow (thermal) neutrons ($v \cong 10^{-3} \text{ m/s}$), and Ω the rotation of the astronomical body, one is able to write down an expression for the phase shift (16) directly in terms of the axial Torsion by simply inverting the Nitsch-Hehl formula (as explicitly computed by Zhang)

$$Q = \left(\frac{R_S}{R} \right)^{1/2} \Omega. \quad (17)$$

Where $R_S = \frac{2GM}{Rc^2}$ is the Schwarzschild radius and R is star radius. Substitution of $\Omega = \left(\frac{R}{R_S} \right)^2 Q$ into (16) one is able to express the phase shift immediately in terms of Torsion

$$\Delta\phi_{TG} = 2 \left(\frac{W}{c} \right) \left(\frac{R}{R_S} \right)^2 Q A. \quad (18)$$

This is similar to the formula (14). Instead of the magnetic field B like in the A-B experiment we have the Torsion vector Q .

Finally let us compare our result with Anandan's 1977 phase shift for the Schwarzschild field (nonrotating star)

$$\Delta\phi_G = -\frac{1}{2} \frac{\hbar}{mc^2} \frac{GM}{R^3}. \quad (19)$$

Let us rewrite result (19) in terms of the Schwarzschild radius $R_S = \frac{2GM}{c^2}$

$$\Delta\phi_G = -\frac{1}{4} \frac{\hbar}{mc} \left(\frac{R_S}{R^3} \right) A \quad (20)$$

From formula (17) expression (20) can be Written as

$$\Delta\phi_G = -\frac{1}{4} \frac{\hbar}{mc} \frac{R_S^2}{R^2} \frac{A}{R} = -\frac{1}{4} \frac{\hbar}{mc} \frac{QA}{\Omega R} \quad (21)$$

and expressions (18) and (21) yields

$$\Delta\phi_G = -\frac{1}{8} \frac{\hbar}{m} \frac{R_S^2}{\Omega R^3 W} \Delta\phi_T \quad (22)$$

and the relation $\frac{\Delta\phi_G}{\Delta\phi_T} = -\left(\frac{1}{8}\right) \left(\frac{\hbar}{m}\right) \frac{R_S^2}{R^3 W} = 10^{-6}$ which implies that the phase shift induced by the Torsion field seems to be bigger than the General Relativistic effect.

In fact Anandan's formula for the case of spin and Curvature (no Torsion) $\Delta\phi = -\frac{GMS}{mc^3} \frac{WA}{R^3} = 4 - \frac{WA}{mc^3} \left(\frac{GMS}{R^3}\right) \cong -\left(\frac{M}{mc}\right) Q$, where we have used formula (6) for the axial-torsion Q . For the neutron Star the above ratio yields $\frac{\Delta\phi_G}{\Delta\phi_T} \cong 10^{-26}$ which means physically that in the case of neutron stars the Torsion effect is stronger. This was expected, since the neutron star possess $\cong 10^{53}$ spin polarized neutrons[14].

In the case of torsion field is produced by an apparatus on the Earth, such as a ferromagnet the one may use formula (6) and this allows us to rewrite formula (19) as:

$$\Delta\phi_G = -\frac{M}{N_{Fe} mc} .QA. \quad (23)$$

Since $N_{Fe} \cong 10^{22}$ polarized electrons the the A-B contribution from torsion would give $\Delta\phi_G \cong 10^{-10}$ which is a promising result although some orders of magnitude weaker than the present-day accuracy of quantum interference phase shift which is around $\cong 10^{-3}$.

In the case of spinning particles Anandan concluded that when $m \rightarrow 0$, $\Delta\phi \rightarrow \infty$ unless the normal component of the spin $S_n \rightarrow 0$ it means that the massless particles have at most two helicity states.

In the case of torsion one can also say that the torsion vector normal component $Q_n \rightarrow 0$ when $m \rightarrow 0$ and then the torsion has at most two helicity states and can be written $Q = n\hbar c$ as showed before[10]. We may also conclude that massless spinning particles not only travel along null geodesics but also that since the normal component of torsion vanishes massless particles do not interact with the normal part of the torsion. A similar conclusion that photons do not feel torsion was reached by F.W.Hehl[15] some years ago.

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TORSION GRAVITY EFFECTS ON CHARGED-PARTICLE AND NEUTRON INTERFEROMETERS

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Torsion gravitational effects in the quantum interference of charged particles are investigated. The influence of axial torsion in the Schiff-Banhill effect (SB) inside a metallic shell is given. The effect of torsion on the surface of the earth on (SB) experiment is estimated. Torsion gravity effects on the Sagnac phase-shift of neutron interferometry are also computed.

Earlier, Anandan[1] have consider neutron interferometer experiments in spaces with torsion. In his analysis he arrived ar conclusion that to produce a phase-shift of $\Delta\theta \cong 10^{-3}$, as in current experiment with thermal neutrons beans, a torsion field of $Q \cong 10^{-9}cm^{-1}$ would be needed. Anandan[2] also showed that in the Einstein-Cartan of Spin and Torsion these experiments of Collela, Overhauser and Werner (COW) type[3, 4] would require a very weak torsion field of $Q \cong 10^{-43}cm^{-1}$ Just to give an idea of how weaker this field is the torsion field on the surface o f the earth is $Q_* \cong 10^{-24}s^{-1}$ Later Anandan[5] considered the (SB) experiment[6] in the gravitational field of the earth. In this paper, I consider the charged-particle interferometry (SB) experiment on torsion backgrounds. The basic new feature here is that the torsion field of the earth is the one given by Nitsch and Hehl[7]; (see also Nitsch[8]) using a PPN aproximation of a translational gauge theory of gravity with torsion. Their result is $Q_* \cong 10^{-24}s^{-1}$ Unfortunately, the torsion effects on the phase-shift are small as in the Aharonov-Bohm (A-B) case[9, 10] but are interesting from the theoretical point of view. Nevertheless the Sagnac[11] phase-shift of the earth rotation on neutron interferometry yields a very interesting application of torsion since Nitsch-Hehl[7] formula contain a relation between the rotation of the astrophysical objects (planets, stars) and torsion. Which yields a straight forward torsion contribution to the Sagnac effect.

Let us now first consider the extension of SB effect that there must exist an electric field \vec{E}_S inside a metallic shell that has no currents. This \vec{E}_S satisfies $m\vec{g} + e\vec{E}_S = \vec{0}$ in the nonrelativistic limit.

The SB idea was proved[12] inside a hollow cylinder only for temperatures of $\sim 4.2K$. Above this temperature, this field undergoes dramatic changes that are not yet understood.

Let us consider the extension of the SB equation to include torsion as:

$$0 = m \frac{d\bar{v}^\mu}{dT} = -\{\nu^\mu \quad \rho\} \bar{v}^\nu \bar{v}^\rho + F_\nu^\mu \bar{v}^\nu - \frac{3}{4} S^\nu \partial_\nu Q^\mu. \quad (1)$$

Where $v^\mu \cong \hbar k^\mu / m$, k^μ being the wave vector, for a typical electron and the bar denotes averaging over the 3-velocity u and neglecting $O(u^4/c^4)$ terms. The last therm in equation (1) has been computed by Sabbata and Gasperini[13]. Writing equation (1) in 3-vector rotation yields.

$$m\vec{g} + e\vec{E}_S - \frac{3}{4}(\vec{S} \cdot \nabla)\vec{Q} = \vec{0}. \quad (2)$$

Which is the generalization of SB equation to include torsion effects. Just considering torsion contributions ans electrical effects, we are left with:

$$\Delta\theta_{SB} = -\frac{e}{\hbar} \delta A_0 T = +\frac{e}{\hbar} \left(\int \vec{E}_S \cdot d\vec{r} \right) T. \quad (3)$$

Which implies for the phase-shift torsion contribution.

$$\Delta\theta_{SB}^{torsion} = \frac{Qd}{v} = \frac{mQA}{r\hbar K}. \quad (4)$$

Where r is the distance between two hollow cylinders in SB experiment. And $v \cong 10^8 cm/s$ for electrons in copper. Considering the torsion field contribution from the gravitational field of the earth $Q_* \cong 10^{-24}s^{-1}$ this effect is extremelly weak.

$$\Delta\theta_{SB}^{torsion} = 10^{-19}d. \quad (5)$$

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In the nonrelativistic limit of the torsion less case $\Delta\theta_{SB} = -\Delta\phi_{cow}$ where $\Delta\phi_{cow}$ is the phase-shift of the Collela, Overhauser, Werner (COW) experiment given by $\Delta\phi_{cow} = -\frac{m^2 g A}{\hbar^2 K}$. In our case the torsion contribution to the Cow experiment is extremely weak and does not affect the experiment. To see this is enough to check that $\Delta\theta_{SB}^{torsion}/\Delta\theta_{SB} \cong \frac{Q}{mr} \cong 10^{-24} \cong 10^{26}!$ which is a very small number to introduce any measurable results on the experiment. Despite of this null result for SB experiment I shall demonstrate next that the influence of torsion on the Sagnac effect is not so small.

Let us consider a torsion contribution to the Sagnac effect[14]. This effect is very similar to the London moment equation for a superconductor with an angular velocity $\vec{\Omega}$ [5].

$$\epsilon \vec{B}_L + 2m\vec{\Omega} = 0. \quad (6)$$

The Sagnac effect yields a phase-shift as:

$$\Delta\phi_S = -\frac{2m}{\hbar} \int \vec{\Omega} \cdot d\vec{S}. \quad (7)$$

Where S is a surface spanned by the neutron beams in the neutron interferometry experiment. $\vec{\Omega}$ is the earth's rotation in the case of terrestrial experiments. By inverting the Nitsch-Hehl formula one obtains a relation for $\vec{\Omega}$ in terms of torsion.

$$\vec{\Omega} = \left(\frac{R}{R_S} \right)^2 \vec{Q}. \quad (8)$$

Where $R_S = \frac{2GM}{c^2}$ is the Schwarzschild radius. Substitution of (8) into (7) one obtains a Sagnac phase-shift due to torsion.

$$\Delta\phi_S^{torsion} = -\frac{2mQ}{\hbar} \left(\frac{R}{R_S} \right)^2 A \quad (9)$$

In the case of the earth, $Q_\star \cong 10^{-24} s^{-1}$, $m_n \cong 10^{-24} g$, $\hbar \cong 10^{-27} cgs \text{ units}$, $R_S \cong 10^6 cm$ and $R_\star \cong 10^8 cm$. Substitution of these data into (9) yields.

$$|\Delta\phi_S^{torsion}| \cong 10^{-17} A. \quad (10)$$

This gives some hope to detect torsion increasing the α area enclosed by the neutron beams, for terrestrial laboratories experiments a typical value for the area is $A \cong 10^4 cm^2$, for this value the Sagnac-torsion effect is $\Delta\phi_S^{torsion} \cong 10^{-13}$ which is a small value to be detected. This is of the same order of the Aharonov-Bohm (A-B) effect on iron magnet rotating tube.

For exemple the A-B effect computed by H.Peng[14] the phase-shift is given by:

$$\Delta\phi_{A-B} = \frac{4m}{\hbar} \iint \vec{B}_g \cdot d\vec{S} = \frac{2Gm\pi R^4 \rho}{\hbar c^2} \Omega = 10^6 m. \quad (11)$$

Where m is the particle's mass and \vec{B}_g is the gravitomagnetic field. For electrons $\Delta\phi_{A-B} \cong 10^{-21}$ which

is much weaker than the torsion contribution to the Sagnac phase-shift. More on this can be found on a recent paper edited by myself and Sivaram on the Torsion Gravitational A-B Effect[10].

A more recent account on the Sagnac effect on neutron interferometry has been considered recently by B.Mashoom in the framework of Special Relativity. A more detailed investigation on the torsion influence on the Sagnac effect can appear else where.

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ON THE COMPOUND STRUCTURES OF THE NEUTRINO MASS AND CHARGE

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The mass and charge of a particle correspond to the most diverse form of the same regularity of the nature of this field. As a consequence, each of all possible types of charges testifies in favor of the existence of a kind of the inertial mass. Therefore, to investigate these features we have established the compound structures of mass and charge. They can explain also the availability of fundamental differences in the masses as well as in the charges of Dirac and Majorana neutrinos.

One of sharply expressed features of the interaction of Dirac ($\nu_D \neq \bar{\nu}_D$) and Majorana ($\nu_M = \bar{\nu}_M$) neutrinos with field of emission [1, 2, 3] is the connection between these phenomena and character of the structure of fermions [4, 5, 6, 7] themselves. At the same time a question about the nature, similarity and difference of masses of neutrinos of both types [8] remains thus far not finally investigated.

The nature is, according to well known considerations, created so that all the forces in it be have the unified regularity. From this point of view, becomes possible use the Newton law of gravity as the Coulomb law and vice versa. In other words, these forces correspond to the most diverse form of the same action. Exactly the same one can as the interacting objects choose the two of neutrinos. Such a procedure, however, takes place regardless of the neutrino structure of whether it is the Dirac or the Majorana fermion. In this a hard connection is said between the inertial mass of a particle and its physical nature.

Our study of elastic scattering of electrons and their neutrinos on a spinless nucleus shows [9, 10] clearly that if the neutrino is the four - component particle ($\nu = \nu_D = \nu_e$) having a Dirac mass m_{ν_D} , it must possess both normal and anomalous electric charges. According to these data, the neutrino full electric charge in the static limit has the size

$$e_\nu = -\frac{3eG_F m_\nu^2}{4\pi^2 \sqrt{2}}, \quad e = |e|. \quad (1)$$

Such a picture leading to the flip of the neutrino spin [11] and reflects the fact that the mass and charge of a particle correspond to two form of the same regularity of the nature of its structure [9, 10].

For further purposes of a given work it is desirable to remind about the electron mass. From point of view of the classical theory of electromagnetic mass [12], the availability of the eigenenergy E_0 of the electron electrostatic field implies the existence of the electric part of the electron rest mass:

$$m_e^{em} = \frac{E_0}{c^2}.$$

The assumption has even been speaked out that all the mass of the electron is equal to its electromagnetic mass. This idea was simply called a hypothesis of field mass.

From our earlier developments, we find that a particle mass is strictly multicomponent. One of them corresponds to the electric charge and can be called a Coulomb mass. Insofar as the electrically neutral neutrino [13] is concerned, its mass does not contain the part, at which it would have as well as an electric charge.

The difference in the masses of Dirac ($\nu = \nu_D$) and Majorana ($\nu = \nu_M$) neutrinos is observed because each of all possible types of charges of the same neutrino arises as a consequence of the availability of a kind of the inertial mass. Thereby this mechanism leads to the appearance of the united rest mass m_ν^U of the neutrino equal to all the mass of a given particle. Its general structure at the account of nonweak [14, 15] and unknown properties of the neutrino has the form

$$m_\nu^U = m_\nu^E + m_\nu^W + m_\nu^S + \dots, \quad (2)$$

where m_ν^E , m_ν^W and m_ν^S denote respectively the electric, weak and strong components of mass. Such a sight to the origination of m_ν^U quality explains the presence of the united charge e_ν^U of the neutrino equal to all the

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charge of a given fermion which contains the electric e_ν^E , weak e_ν^W , strong e_ν^S and some other parts:

$$e_\nu^U = e_\nu^E + e_\nu^W + e_\nu^S + \dots \quad (3)$$

So, it is seen that the mass and charge of a Dirac particle include in self both electric and unelectric components. Of course, our formula (1) characterize only a Coulomb mass dependence of the electric charge:

$$m_\nu = m_{\nu_D}^E, \quad e_\nu = e_{\nu_D}^E.$$

Using this and by following the fact that the force of Newton attraction between the two neutrinos is less than the force of their Coulomb repulsion, we find that

$$m_{\nu_D}^E > 1.53 \cdot 10^{-3} \text{ eV}, \quad (4)$$

$$e_{\nu_D}^E > 1.46 \cdot 10^{-30} \text{ e}. \quad (5)$$

It is clear, however, that the finding values of (4) and (5) are incompatible with the available laboratory data [16]. At the same time this circumstance may serve as some confirmation of the availability of compound structures of mass and charge.

Thus, it follows that if neutrinos are of electrically neutral ($\nu = \nu_M$) then $m_{\nu_M}^E = 0$, $e_{\nu_M}^E = 0$, and the side of $m_{\nu_M}^U$ and $e_{\nu_M}^U$ are reduced to the form

$$m_{\nu_M}^U = m_{\nu_M}^W + m_{\nu_M}^S + \dots, \quad (6)$$

$$e_{\nu_M}^U = e_{\nu_M}^W + e_{\nu_M}^S + \dots \quad (7)$$

Comparing their with (2) and (3) at $\nu = \nu_D$, it is easy to observe the fundamental differences in the masses as well as in the charges of neutrinos of the different nature.

Of course, the above - noted regularities of general picture of massive neutrinos extending well known hypothesis of field mass meet with many problems which require the study of the structure and property of each of existing types of charges and masses.

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