Prof. PETAR RASHKOV PENCHEV, Doctor of Technical Sciences
Doctor Honoris Causa of the Technical University of Sofia

PHYSICS
the 21st century
based on a single, unitary principle

"All bodies emit and absorb light"
"Bodies convert into light, and light into bodies"
"These are normal natural processes"
I. Newton (Optics, 1704)

"I have long shared the idea,
which has become my own conviction, that the various forms,
in which forces of matter manifest themselves,
have a common origin".
Michael Faraday (1891-1860)

"Our ideas of reality cannot be final, so we should always be ready to change our point of view, i. e. to change the axiomatic basis of physics so as to substantiate the new experimental data observed by us into a logically most perfect way."

A. Einstein, 1931

Technical University of Sofia
2008

Summary

The experimental data that electrons and positrons generate electric, magnetic and gravitational fields, and that photons, protons and neutrons are generated during their interaction, lead to the following inferences: a) protons and neutrons have the electromagnetic nature of electrons and positrons, which are the smallest independent bipolar electric charges and b) atoms (molecules), which are a structure of electrons, protons and neutrons, have electromagnetic nature as well – i.e. atoms are electromagnetic matter.

The analysis of the above facts endorses the idea that they, as a whole and as parts, can be described only by the equations of J. C. Maxwell and of S. Poisson (1813) about Newton's gravitation. For this purpose, they are organized into a system of six equations called Principal, which is sufficient to describe all natural phenomena as a unitary whole.

$$\left.\begin{array}{lll} \text{a) } rot\vec{E} = -\dfrac{\partial \vec{B}}{\partial t}\,; & \text{b) } div\vec{D} = \rho_e\,; & \text{c) } \vec{D} = \varepsilon_0 \vec{E}\,; \quad \text{I} \\ \text{a) } rot\vec{H} = +\dfrac{\partial \vec{D}}{\partial t} + \vec{j}\,; & \text{b) } div\vec{B} = 0\,; & \text{c) } \vec{B} = \mu_0 \vec{H}\,; \quad \text{II} \\ \text{a) } rot\vec{G} = 0\,; & \text{b) } div\vec{G} = -\rho.4\pi.\gamma\,; & \text{III} \end{array}\right\} \quad \text{(A)}$$

It has been proved that both the theory of relativity and de Broiglie's waves are unsustained, because they contradict the law of energy conservation.

It has further been proved that thermodynamics is a specific electrodynamics ruled by deterministic, not probabilistic laws, and therefore entropy has been rejected as well.

Sofia, November 2007

Address for contacts:

Prof. Petar Rashkov Penchev, D.T.S.
Mladost I, bl. 90, entr. 9, Sofia 1797
home phone +359-2-8706805
e-mail: iliana@tu-sofia.bg
yatchev@tu-sofia.bg

© Prof. Petar Rashkov Penchev, D.T.S., The 21st century Physics based on a single unitary principle, 2007.

Contents

The Big Bang message about the laws of nature

Prof. A. Y. Smorodinskiy, in the introduction to his book *Photon's Relatives*, publ. by Znanie, Moscow, 1986, writes: "There is a growing conviction that all forces in nature are closely interrelated and are inherent manifestations of a unitary field. The homogenous theory of field starts from the premise that in the process of evolution of Universe, the character of interaction among particles has changed. The interaction of various forces, observable today, were not different when the Universe was still very young".

The modern physicists' idea about the initial evolution of the Universe (the world, the nature) and about its present state is as follows:

Approximately 10^{10} years ago, the universe (the nature) was one whole in the form of a small (point-like) object (body) which self-exploded and started expanding and restructuring, a process still going on today.

It was in that process that the present state of Universe emerged as a set of stellar systems, in one of which is located our planet Earth.

There is a consensus on the fundamental proofs of this thesis, such as:

a) the Hubble effect;

b) the relict radiation;

c) spectral analyses of objects from other stellar systems confirming the scientific observation that their matter is identical to the matter of our Earth.

Therefore, a general inference follows, supported also by scientific observations, that the initial resource, out of which both the Universe and our Earth were created, has the same essence (nature), i.e. the same substance (substratum) – the resource is homogenous.

However, experience from the theory of Earth has shown that, at the present level of knowledge, the smallest material fragments (elementary particles) of matter are formed by (consist of) some unknown homogenous resource, which is herein referred to as homogenous substance. This homogenous substance is not known in its explicit state (it does not manifest itself), but it manifests in the form of independent structural states, at the lowest known level of organization, as independent bipolar electric charges - q_e, or as elementary particles, respectively: electrons with $q_e < 0$ and positrons with $q_e > 0$. These charges generate electric - *E*, magnetic - *H* and gravitational - *G* fields, and corresponding energies and masses.

During their interactions, these elementary particles, denoted respectively with e^- and e^+, being an initial resource, under proper conditions, get restructured into photons γ and vice versa, or into protons (proton p and antiproton $\overline{p}$), or into neutrons (neutron *n* and antineutron $\overline{n}$), as follows.

In the interaction between the electron - e^- and positron - e^+ at:

α) velocities $v \cong 0$; $\rightarrow$ $e^- = e_0^-$ and $e^+ = e_0^+$; (P-1)

a) $e_0^- + e_0^+ \rightarrow 2.\gamma$; b) $2.m_{e0}.c^2 = 2.h.\nu$; c) $\gamma_r \rightarrow e_0^- + e_0^+$;

d) $2h.\nu_{\rm r} = 2.m_{\rm eo}.c^2$ (P-2)

Emphasis: Since e^-_0 and e^+_0 (the electron and the positron) are at rest (v=0), while the photons generating electrons and positrons are in motion at velocity c, the substance, out of which electrons and positrons are formed, is the carrier not only of the resource (substance) at rest, but also of the motion, but it is not manifested in the motion, i.e. substance is the resource of the motion of matter as well.

β) the velocity v<c $\rightarrow e^- = e^-$ and $e^+ = e^+$; (P-3)

a) $e^- + e^+ \rightarrow \left(e^-_0 + e^+_0\right) + \left(p + \overline{p}\right)$; b) $e^- + e^+ \rightarrow \left(e^-_0 + e^+_0\right) + \left(n + \overline{n}\right)$; (P-4)

a) $2.m_{\rm e}.c^2 = 2.m_{\rm eo}.c^2 + 2.m_{\rm p}.c^2$; b) $2.m_{\rm e}.c^2 = 2.m_{\rm e0}.c^2 + 2.m_{\rm n}2m_n$; (P-5)

where: $\gamma_{\rm r}$ is a gamma photon; $m_{\rm eo} = q^2_{\rm e}.k_{\rm e}$ - the masses at rest of the electron or of the positron; $k_e = \left(4.\pi.\varepsilon_0.r_{\rm e0}.c^2\right)^{-1}$ - a constant, where ε_0 - the dielectric constant of vacuum; $r_{\rm e0}$ - the computational radius of the electron; c – the velocity of electromagnetic waves in vacuum; $m_{\rm e} = m_{\rm e0}\left(1 - \dfrac{v^2}{c^2}\right)^{-1/2}$ - the mass of the electron (positron) at velocity $v < c$; h - Planck's constant; ν - frequency.

The scientific data set forth above motivate the following laws:

1. All fields (E, H and G) are electromagnetic, because they have the same genetic resource: the electric charge, but since the gravitational G field is function of the mass, or, respectively, of the square of the electric charge - $m_{\rm e0} = q^2_{\rm e}.k_{\rm e}$, herein it is called secondary electromagnetic field.

a) $\vec{E} = \dfrac{\mu.\vec{r}_0}{4{\rm n}\varepsilon_0.r^2} >< 0$; b) $\vec{H} = \varepsilon_0.\left[\vec{v}.\vec{E}\right] >< 0$;

c) $\vec{G} = \dfrac{-m_{\rm e0}.\gamma.\vec{r}_0}{r^2} = \dfrac{-k^2.k_{\rm e}.\gamma.\vec{r}_0}{r^2} < 0$; d) $\vec{r}_0 = \dfrac{\vec{r}}{|\vec{r}|}$; (P-6)

where: γ is the gravitational constant.

2. The energies and the masses of the protons and neutrons are homogenous and electromagnetic, and their correlations are

a) $W = m.c^2$; b) $m = W/c^2$; (P-7)

3. Atoms (At) and molecules have electromagnetic nature because they are structured out of electrons, protons and neutrons, which, as elementary particles are function of (their resource comes from) the electric charge, i.e.

$$A_{\rm T} = \sum p + \sum n + \sum e^- = N_{\rm k} + \sum e^- \quad \text{(P-8)}$$

where the sum $\sum p + \sum n$ is equal to the nucleus N_k of the atom.

4. The material and field form of the electromagnetic matter of the Universe (nature) are distributed non-unformly in its space in the form of various natural fragments (objects, phenomena, processes, etc.) in diverse quantities, densities, structures and volumes, which

determine their versatile properties (manifestations). The latter are the reason for their relative independence and generation of interaction of forces between them – i. e. their eternal alteration (evolution and degradation), which is also their inherent property (fact, nature) of their homogenous substance (matter) to act without any external interference.

In this sense, the Universe is a homogenous material continuum, in which all manifestations (processes, phenomena, interactions of forces, etc.) are homogenous and have electromagnetic nature; this continuum exists and evolves by itself, driven by its own self-reason, i. e. the Universe itself is its own reason of its own evolution based on its own powers (capabilities) in the form of natural laws (facts).

5. The homogeneity of the Universe as a material continuum and the homogeneity of energies and masses and their manifestations, which are electromagnetic in essense, implies that the forces of interaction between the individual natural objects (facts), which have relative independence, mainly due to their relative structural states and differences in the levels of organization of their structural elements, are solely electromagnetic. The reason for this claim is the fact that, according to I. Newton, the forces $\vec{F}$ are derivatives of energies W, (which are only electromagnetic) relative to distance r, which he (I. Newton) presented as the law of energy conservation in interaction of forces between two objects in the following form, on condition that energy dW is measured through work dA,

$$\text{a) } dW = dA = \vec{F}.d\vec{r} \text{ ; b) } \vec{F} = \frac{dW}{dr}\vec{r}_0 = \frac{v.d\vec{P}}{v.dt} = \frac{d\vec{P}}{dt} \text{ ;} \qquad \text{(P-9)}$$

i. e. *the force is equal to the energy released (exchanged) from one to another object per unit of distance (pathway) of interaction. That is why the force measures as [energy over distance] =* $\left[J.m^{-1}\right]$

And since Newton applied the principle of simplicity (Occam's razor) without proclaiming it, he used the description of the force through the derivative of momentum $\vec{P}$ *related to the time.*

If we use (P-7) and instead of energy we use $m.c^2$ from (P-9) the result is

$$\vec{F} = \frac{dW}{dr}\vec{r}_0 = c^2.\frac{dm}{dr}\vec{r}_0 \text{ ;} \qquad \text{(P-10)}$$

i. e. *the force is also described by the derivative of the mass.*

If the density of the mass is $\rho_{\text{m}} = const$, and the volume is $V = \text{var}$, the mass is $m = \rho_{\text{m}}.V$, and the expression of the force from (P-10) is

$$\vec{F} = c^{2.}.\rho_{\text{m}}.\frac{dV}{dr} \qquad \text{(P-11)}$$

It is essential here that the force is proportional to the mass density of the acting object and it has solely electromagnetic nature, such as the energy and the mass of the object.

The relation of the forces of interaction F_1 and F_2 between two objects 1 and 2 of non-uniform density of their energies $w_1 = \rho_{\text{mr}}.c^2 > w_2 = \rho_{\text{mr}}.c^2$ and density of the masses $\rho_{\text{m1}} > \rho_{\text{m2}}$ of equal (same) volumes $V_1 = V_2$, according to (P-11) is

$$k_{\mathrm{F}} = \frac{\left|\vec{F}_1\right|}{\left|\vec{\mathrm{F}}_2\right|} = \frac{w_1}{w_2} = \frac{\rho_{\mathrm{m1}}}{\rho_{\mathrm{m2}}}; \qquad \text{(P-12)}$$

Therefore, the forces, which generate objects are always solely and only electromagnetic, but their features and quantities depend on the structures, densities and quantities of their energies (masses). The forces between two spherical electric charges can be described by most simple formulae. The other electromagnetic forces, depending on the objects which have generated them, have different mathematical formulae, although they too are electromagnetic forces. A classic example of this are Lorenz's formulae for electromagnetic forces.

Therefore, the different features and the value of the forces between the objects require that in their incessant restructuring (while the Universe is expanding) *there should also be a continuous change of the forces of interaction in various aspects (values, features, etc.), regardless of the fact that they are always electromagnetic.* This is so because the Universe has evolved from one outset – the Big Bang from a homogenous point-like object. Through forces, work is done, i. e. the energies and the masses of some objects get restructured into energies and masses of other objects. Or the energies and the masses from some structural states are converted into energies and masses in other structural states, but in their essence they remain homogenous and electromagnetic. *This is the eternal cycle of the initial natural resource of mineral and living and thinking matter.*

6. Theoretical foundations: a unitary deductive principle - Principal

It becomes clear from the aforesaid that the Universe (nature) as one whole and its parts have a homogenous resource called electromagnetic matter or electromagnetic material continuum, and the fundamental definitions of the science which studies the laws of manifestation of matter (processes, phenomena, properties, etc.), as a system of fundamental or basic laws is called theoretical foundation of science or deductive principle. *It is appropriate to think of a science whose subject is nature as one whole, on the one hand, and of sciences whose subjects are parts (manifestations) of nature (material continuum), on the other hand; the former is called herein naturology (in Bulgarian: природология), and the latter are called specialized or specific sciences.* In the scheme of sciences as it is set forth herein (naturology and specialized sciences), specialized sciences are components (parts) of the science naturology. That is why the theoretical foundations of naturology are seen as the basis and fundament of the theoretical foundations of specialized sciences. That is also the reason why the theoretical foundations (the logical fundament) or deductive principle of the science naturology, being concerned with the most general manifestations of matter in the sense of electromagnetic material continuum only (nature as one only whole) are called Principal.

The mathematical description of the Principal (the unitary initial deductive principle) cannot be expressed by one single formula only (equation); a system of differential equations is needed instead, which will describe the most general initial and fundamental principles, which may be:

1. The initial resource - matter (material continuum) and its properties, energies, masses, forces, fields (including gravitational field) etc., has solely and only electromagnetic nature.

2. The initial resource is indestructible nor creatable from nothing, i. e. it is eternal. This principle is synthesized in the law of energy and mass conservation and their restructuring from one into another state, or the law of matter conservation and its restructuring.

3. The various natural objects (manifestations) have a relative independence as regards the material continuum, that is why they are connected and interrelated via force structural connections into one whole: the nature.

Forming the Principal into a system of differential equations at the present level of knowledge of nature is possible by using two classical and experimentally well established theories about the perceptible natural phenomena, on condition that electromagnetic resource generates gravitation, i. e. that electromagnetic density ρ_{m} of the mass of the objects generates the gravitational field. These theories are:

- The electromagnetic theory of J. C. Maxwell, further developed by Max Planck, i. e. Maxwell's equations and Planck's theory about photons.
- I. Newton's gravitational theory, denoted as equations by S. Poisson in 1813.

Through the equations of these classical physical theories, a system of equations is formed –

Principal

$$\left.\begin{array}{lll} \text{a) } rot\vec{E} = -\dfrac{\partial \vec{\mathrm{B}}}{\partial t}\text{; b) } div\vec{D} = \rho_{\mathrm{e}}\text{; c) } \vec{D} = \varepsilon.\vec{E} & \text{I} & \\ \text{a) } rot\vec{H} = \dfrac{\partial \vec{D}}{\partial t} + \vec{j}\text{; b) } div\vec{B} = 0\text{; c) } \vec{B} = \mu.\vec{H} & \text{II} & \\ \text{a) } rot\vec{G} = 0\text{; b) } div\vec{G} = -\rho_{\mathrm{m}}.4\pi.\gamma & \text{III} & \end{array}\right\} \quad \text{(P-13)}$$

where: $\vec{D}$ and $\vec{B}$ are the electric and the magnetic inductions; $\vec{E}$, $\vec{H}$ and $\vec{G}$ - the electric, magnetic and gravitational fields; ε, μ and γ - the dielectric, magnetic and gravitational constants; ρ_{e}, ρ_{m} - the densities of the electric charge and of the matter (the mass); j – the density of electric power (if any); t - time.

Consequences from the Principal:

1. It describes the unity of regularities both of field and material forms of matter.

2. It proves the unity of electromagnetic and gravitational fields, i. e. their genetic sameness.

3. It shows that at $\rho_{\mathrm{c}} = 0$, the unity and inseparability of electromagnetic waves is described alongside with electric, magnetic ($\vec{E}$ and $\vec{H}$) and gravitational field $\vec{G}$ through the respective densities of their matter $\rho_{\mathrm{c}} + \rho_{\mathrm{H}} = \rho_{\mathrm{m}}$.

4. That there exists a genetic relation between the fields and the material forms of matter, and that they can convert into one another.

5. (P-13) gives grounds to the fact that in nature (the world), without any discontinuation within its space, there exists electromagnetic matter and matter in the form of gravitational field (electromagnetic field of second type). This is to say that (P-13) is also an expression of the principles of matter in nature as follows:

5.1. Principle of unitary electromagnetic matter in nature (the world).

5.2. Principle that nature is a material continuum, i. e. that matter in the nature is continuous or that there is no place without matter in the nature.

5.3. The synthesis of principles 5.1. and 5.2 leads to the Conclusion that: **The notion of electromagnetic continuum or material continuum are synonymous to the notion of nature (world).**

When integrating this system of equations (P-13) under relevant boundary conditions for a particular situation, we derive the regularities of the relevant natural manifestations.

It is clear from them that there is no natural phenomenon without simultaneous participation of electromagnetic and gravitational fields, for every electromagnetic field has its mass – density of the mass ρ_m, and it generates a gravitational field.

And in independent electromagnetic fields without electric charge ($\rho_e = 0$) we obtain electromagnetic waves whose masses generate gravitational fields, i. e. the densities of the masses ρ_{mE} and ρ_{mH} of the electric E and magnetic H fields of the waves generate gravitational fields.

Emphasis

There is a requirement on scientific methodology: *"When a new law is discovered in a certain field of science, that law must be applicable in all fields of science."*

In this sense, the Big Bang messages, which were set fourth above, and especially the principle of homogeneity of energies and masses as electromagnetic ones, need to become fundamental in physics.

Conclusion

From a fundamental (general) point of view, the first and genetic property of matter and its manifestations (including its gravitational field) have solely and only electromagnetic nature, i. e. **matter and its genetic manifestations, as well as all interactions of forces, as causal genetic phenomena, have solely and only electromagnetic character, i. e. that the principle of electromagnetic nature of matter has no alternative and is definitely an adequate groundwork principle of physics.**

Methodological essay

M. 1. General assumptions

The main purpose of physics is to unite, by some common properties, the multiple manifestations of physical phenomena in the Universe into a whole system which should meet the following requirements: **First** – *it should have a hierarchical order in respect of cause and effect relations;* **Second** – *it nature should be genetically unitary as a material (substantial) essence;* **Third** – *it should describe the Universe as a whole material continuum of material and field form of matter – as a natural fact, and* **Fourth** – *it should recognize the fact that matter itself, according to Spinosa, is the carrier and generator of its manifestations* - ***Causa Sui*** (the matter is itself the cause of its manifestations). These manifestations, generated by the matter itself (without any external interference), are the subject of scientific research for deriving experimental data, ***which, after being interpreted, become scientific facts, which are the initial resource (basis), and alongside with that, a logical basis of science.***

In this sense, scientific knowledge has its empirical basis, for the process of thinking, through which knowledge is created, has always been based on the resource of reflection of natural phenomena in human mind. That is why the meaning of the theoretical foundations - of the logical groundwork of physics (of the knowledge about physics), which are presented as its theoretical or empirical foundations, in their essence have always had (directly or indirectly) their roots in the experimental regularities of nature. In this respect (meaning, sense) the new ideas, which originate in human mind (even when considered purely intuitive) are based on the resource of reflected facts from the natural data in human mind. Out of this resource, through the process of scientific thinking, the physical truth is deduced as (forged into) laws, principles, definitions etc. about natural phenomena. *And postulates are intuitive visions (ideas, laws, principles) about realities, and* **only after empirical validation of these visions (models), do they assume a status of physical truth – a physical law, formulation or value.**

There is a saying about fundamental truth, that the criterion of adequacy of knowledge is the experimental validation of observations. With reference to this, A. Einstein wrote: **"In order to recognize a theory as a physical theory, the inferences (claims) resulting from it should be liable to empirical verification."**

Scientific facts have irresistible logic of proof and, similarly to Archimedes' point of support strog enough to move the Earth, they are Archimedes' scientific point (fact) of support which can shatter (disprove) even the most stable (unshakable) ***scientific theory,*** and ***especially so if that theory cannot present*** *convincing experimental results,* ***but is based on the scientific authority of its researcher, or author.***

The irresistible strength of experimental data **can be explained by the circumstance that such strength is a logical necessity for them.** *That is why in science, always, whether we want it or not, we must unconditionally accept the*

experimental scientific facts as scientific truth, for they in their essence are empirical regularities and have irresistible strength because they are a logical necessity – an expression of the logic of the experiment. Therefore, the criterion of truth for a theory means that the experimental (empirical) regularity is a logical necessity for a theory.

In science, the method of abstraction (idealization) should always be applied; this method was introduced by Galilei (1564-1642) and demands that the studied fragment should be cut off (severed) from the whole, from the world. Then the abstract notion from the reality is ascribed only that part of multiple properties of the reality, which are necessary and sufficient for the purpose of the manifestations (properties), or processes under study. This means that an abstracted notion will always carry only part of the multiple real manifestations, due to which circumstance (condition), it is not completely adequate to the natural fact and its relevant realities, being only a fragment of the whole, because it itself has a simplified (abstracted) content of properties as a natural fact. Owing to this indicator of incompleteness, it can in some specific conditions also manifest as a carrier of impreciseness and incompleteness with regard to the theory, in whose shaping it participates, if the purpose of the study has not been realized consciously and completely, and thence comes the preciseness of abstracting. In this respect, one of the reasons why some theories cannot be considered a fully reliable fragment of the science physics may be some flaw in abstracting one or more of the primary quantities.

Here comes the question of relation between the common sense and scientific thought. This relation is balanced only when a scientific argument (vision, conclusion) has resulted from the scientific thinking and has been empirically validated in nature. That is to say, the common sense is a scientific truth only when it is logically correct, since logic is the abstract reflection of the experimental data and is a structure of empirical regularity (empirical manifestation (fact) because this regularity is a logical necessity of the interaction). **In this respect, scientific facts are always real models for gnoseological analyses of processes related to our knowledge of reality and only then do they adequately reflect their essence.**

That is exactly why R. Descartes said that no scientific claim should be trusted before it was checked.

Heretical appears Richard's Feynman's thought too, when he wrote:

"Physics has still not turned into a unitary construction, where each part is in its place." and "If all principles were put together, WE COULD SEE THAT THERE ARE EXTREMELY MANY OF THEM AND NOT ALL OF THEM ARE COMPATIBLE WITH ONE ANOTHER".

These words by the Nobel Prize winner state not specifically, but really and in a categorical way, that presently in physics there do exist **ad hoc** hypotheses, lapses and flaws, incorrect or experimentally not verified truths, or long outdated truths which used to play certain role in physics, but which should now be dropped off, such as: the well-known Michelson and Morley's experiment for detection of luminiferous ether, or the non-observance of Galileo's principle of relativity.

But R. Feynman very clearly and directly spoke of the presence of initial and basic principles out of which should be formed the foundations of physical knowledge, and he

wrote: **"But all that diversity of separate laws** IS PIERCED BY A FEW COMMON PRINCIPLES, WHICH, IN ONE WAY OR ANOTHER, ARE CONTAINED IN EACH LAW."

Only when nature is interpreted as a whole, as an entity making a united whole, as a system of its parts (natural phenomena), can nature reveal in the fullest its major laws (principles) of relations (interrelations) between them and the whole. ***It is their integral consolidation and the principles of the whole system (nature) that is the purpose of this study.***

The notion of unitary science should not be understood (taken) as a requirement to reduce science to one formula or one system of equations only, but it should be understood as a requirement that science should have an initial principle, since nature as a whole is one system, structured by material elements (realities) in the form of material bodies, manifestations and processes, which are interrelated because they are bound through force (structural) connections, i. e. it is a common material whole (material continuum). *Therefore, there are no realities without matter – there is no nature, or the notions of matter and nature are in their essence synonymous.* **Because of this condition, we can think of a unity of sciences only with homogeneity (unity) of the matters of the diverse natural phenomena (realities).** *Or, the unity of sciences depends only on the condition that matter in the nature (the world), as a whole, is homogenous in its essence, i. e. matter manifests in diverse parts, which are objects different in structure and organization yet having a homogenous genetic essence.*

Herein, under diverse parts (objects) it should be understood such ones made of inanimate (mineral) and animate (living organisms) matter, including the human one, *because animate matter is product of mineral matter.*

M. 2. Methodological formulations

It is known that science does not construct images mirroring the natural phenomena (realities), but it constructs models of them which are simplified (idealized, abstracted), using simplified (idealized, abstracted) notions in conformity with the objective (purpose) of each scientific study. In this way a model is created, which contains only essential (significant) major properties (manifestations) of the realities (natural phenomena, objects) in conformity with the purpose of the study.

The notion of reality should be understood as something material (in a field or material or both forms of matter), which can be perceived (sensed) directly or indirectly through human senses. The notion of these realities, perceived by humans, after certain interpretation assumes the rank of a scientific fact, expressed through a relevant notion.

It should be emphasized, that the realities always (immutably) have the physical property of quantity (quantitative relations) which are the subject of mathematics. Because of this circumstance, mathematics can describe, in the language of quantities (quantitative relations), the phenomena (processes, objects) of all sciences, which deal with (use) only strictly simply defined quantities in the form of relevant notions.

The thing that generates diverse realities (natural phenomena, nature) is called matter. It is the carrier and generator of realities and is synonymous to the notion of nature. *When studying the realities (natural manifestations, including those of humankind as an element of nature), the matter, or rather its manifestations, are always the initial principle and logical point of support in the conceptual interpretation of the diversity of facts (manifestations).*

THAT IS TO SAY THAT MATTER, AS A CARRIER AND GENERATOR, IS THE CAUSE AND EFFECT OF ITS OWN (NATURAL) MANIFESTATIONS. Or *it is itself the reason and sequence of the diversity in nature, and this exists without any external interference; i. e. the matter causes its parts (fragments) to reproduce themselves from one fact into another (object, manifestations).* **Therefore matter is the outset (the cause) and the end (the effect) of all realities (manifestations, processes).**

THAT IS TO SAY THAT MATTER, IN SUBSTANTIAL ASPECT, IS THE CARRIER BOTH OF ITS ETERNITY – OF THE PRINCIPLE OF ITS CONSERVATION – AND OF THE TRANSIENCE OF ITS STRUCTURES, OF ITS MUTABILITY, OF THE PRINCIPLE OF ITS INTERACTIONS, I. E. OF THE LOGIC (LAWS) OF ITS PROCESSES WHILE ALWAYS CHANGING ITS FACTS IN TIME AND SPACE, IN THE NATURE. That is why when studying not only parts (separate objects, manifestations) but the nature as a whole, because the nature (matter) manifests itself in a way for which there are natural conditions, above all we should consider the conditions and they should be the reason of some of other manifestations, subject to relevant laws.

In the meaning of the aforesaid, matter is not a metaphysical body, but a unity – a complex of its diverse facts (manifestations) or a complex entity in a field and material form: a material continuum.

It should be noted that matter, as mass *m,* and its property, energy, do not exist as separate quantities. *They are always inseparable from each other, because energy is a property of the conceptual (complex) notion of matter, and that is why matter and energy cannot exist separately from each other*. Matter and energy, according to physics, are related to the velocity of light *c* through the regularity,

$$W = m.c^2 , \qquad \text{(M. 2-1)}$$

which is universal. **And always, when it is spoken of energy W, unconditionally should also be considered the fact, that it has a carrier, a corresponding quantity of matter, or mass *m*.**

$$m = W / c^2 ; \qquad \text{(M. 2-2)}$$

and vice versa, when matter is meant, it always goes alongside with energy, i. e. matter as a synonym of nature, in the methodology of knowledge (scientific studies, sciences), should be considered as a tentative abstraction (theoretical construct) of the carrier and generator of the commonest in the diversity of objects: their property of materiality, which characterizes their unity and reality. *Or, respectively, matter is the only groundwork and initial value (basis), initial resource, which is the carrier, source (cause) of the realities and all natural phenomena (objects, manifestations) in nature.*

The above statement contains the scientific belief and creed of the author of this

study – this creed is a scientific model rooted in the the following fundamental thesis:

The groundwork and the criterion of veracity and reliability of our knowledge about nature and its specific facts (objects, manifestations) is the experiment, or practice. *This thesis is based on the idea that each natural reality (manifestation) is material, i.e. that there is no reality that could not be perceived by the human mind, by means of our senses (directly or indirectly), and by means of our logical thinking.*

the primary purpose of science (scientific study) is to unite the vast diversity of natural manifestations having common properties into one whole system meeting the following requirements:

First - it should have a genetically unitary material essence;

Second – it should have hierarchical order of its cause-and-effect relations;

Third – it should reflect the fact that the Universe is in its essence a homogenous material continuum of material and field forms of matter (natural phenomena);

Fourth - it should reflect the fact that matter itself (the material continuum) is the carrier and generator of its own manifestations (Natura causa sui est - Spinosa);

Fifth - that *human mind (brain) there is nothing else real than that, which was perceived through the senses or human thought, as a reflection of natural phenomena or of human thoughts.* Due to this fact (reason), it is only the aggregate sum of these reflections that forms the initial resource (row material) of knowledge, of the truth about the world; this is done via processes of thinking (mental models and experiments) – by means of internal cerebral material processes of interaction, i. e. between the material carriers of images;

Sixth - that matter, which is the carrier and generator of natural manifestations, is not a compact object (fragment) in the form of metaphysical body, but a complex entity of its diverse manifestations in space and time, i. e. a mentally idealized (abstracted) object. Or *matter is the primary initial logical point of support in conceptual interpretation of reality.*

Or in this form and meaning as a conceptual notion, matter is the only primary and initial (starting) basis (idea) for forming (constructing) of a scientific view of nature and its parts (fragments), since all studied phenomena and their laws are product of matter.

In this respect matter is not inactive (passive), but active because it carries in itself the active principle called the reason of its own conservation (existence) and evolution.

Seventh – the veracity of the truth of the scientific claims (thoughts), in the form of inferences and laws, definitions and principles, can only be proved by relevant supportive experiments and facts (empirical regularities), ***i. e. that no non-empirical (apriori) truths or sciences exist, but all sciences use (are basically product of) the principle of observation of material manifestations - experimental data.***

The above idea is grounded in the circumstance that experimental data have the status of irresistible strength of proof or that they have the status of an irresistible proof – ranking to a principle and argument for reliable information and truth. **That is to say that the material experiment is a material expression of the logic (truth, regularity) –**

the logical necessity – of the reliable, veracious idea about the essence of the relevant natural fact in dynamic aspect, *where regardless of whether we want it or not, the experiment is imposed on us as an unconditional irresistible natural truth.* And *that is why the experiment is a logical point of support for evidence and inferences from natural truths - logical laws.* And the summarized inferences from the experimental data are the beginning (the root) of theoretical inferences (laws), which, *when they are more comprehensive, are called logical laws* – and the system of them is called logic, and they always have an empirical basis, i. e. a material origin, **because there is nothing real which is not material.**

In support of the above reasoning come some maxims, such as:

- "Even gods remain speechless before facts" or, paraphrased "Even genii concede to scientific facts";
- "Facts have an irresistible strength of proof";
- "True is only that idea which has an analog in nature";
- "Science is an offspring of experiment" – Leonardo da Vinci (1452 -1519);

Eighth - the theoretical or logical laws (the logic), are applicable for reliable interpretation only in thoughts (claims), which are reliable (experimentally validated) truths (facts) about natural phenomena. Otherwise, when interpreting unreliable truths by logical laws (logic) we will derive non-truths. The reason for this requirement (property) of logical laws (the theoretical foundations) is the circumstance, that they are only generated by (are product of) real (reliable) natural phenomena.

Here we should emphasize the fact that, in general, all laws are logical laws, because they are an expression of truth - of the essence of the relevant natural phenomenon (manifestation) - of an empirical fact. In this sense, the essential meaning of the notions expressed via the terms - *law, logic, principle and truth are synonyms*, which validate the reliability of the relevant empirical regularity manifesting itself in a relevant experiment. *In practice, the term logic (logical) is most often used about more comprehensive and more general, yet reliable regularities.* While the term law is used for specific explicit manifestations.

M. 3. On the notions of explicit and potential (implicit) properties

Explicit properties (manifestations) of parts, systems of parts or of nature as a whole are only these properties, for which there are or there have been conditions (situations) when they are in the form or condition where their existence can be observed and they can be registered as observable.

And those regularities (properties) of the objects (parts, systems or of nature as a whole), for which up to this moment there have not been proper conditions to manifest themselves as explicit are called potential laws (properties). And they are such until the moment when conditions arise for them to become observable. The number of the potential regularities (properties) of each object is unknown, and because of this fact, an indeterminate number of notions for diverse properties (manifestations) of object (the system, the nature) can be formulated from their unknown number. Or by the notion of diversity or diverse manifestations it should be

understood that if there are n known (explicit) diversities of an object, then there always exist $m > 0$ more potential (unknown) diversities.

For example, Newton's mechanics, which was developed without the field form of matter, was without the potential property of field matter. Whereas Maxwell's electrodynamics is based on explicit field property of matter, which now also consists of electromagnetic fields. And **thus, the discovery of the potential properties of an object as explicit ones may lead to new theoretical inferences.** *Therefore, the availability of potential properties leads us to the conclusion, that any new theory can always be the last but one word (theory) in its respective scientific area.*

M. 4. On the synonymy of the notions of scientific, theoretical and logical.

The theoretical foundations (regularities) as well as the logical foundations (laws) - the logic of sciences start forming (amassing) themselves in the human mind from a human being's birth to the end of his conscious life in the form of experimental resource, through observation and mental activities (education, media (radio, television), literature, etc.). This is actually the initial logical resource (product, raw material), which is then processed by the material mental process in the brain so that new truths (logical inferences) may be deduced as the scientific resource of science (study). *Due to the above, there is no place here for any non-material activities brought into scientific studies via the notion of apriori, i.e. something before the experiment.* There is no veracious idea that does not contain anything true; for there is no non-material reality – there is not anything and there cannot be anything which, being generated in reality, was not generated by something (something material).

In the above sense, self-evident are the following truths:

First - that there are no laws, which are not logical, as long as they meet the requirements of a reliable, experimentally validated truth, which has an analog in nature.

Second - that there is no natural fact (object), whose properties (regularities) are all known (explicit); due to which the number of its diverse manifestations is not known.

Third – the preceding two truths imply that it is impossible to give a complete (exhaustive) description of a natural fact, but only a simplified model of the relevant reality of nature can be given (without its potential and other properties).

Fourth – in scientific studies, the following essential points should be taken into consideration:

1) Each real thing in nature, which is perceived through senses, is material;

2) The notion of matter is a specific synonym of the notion of nature;

3) The initial (raw-material) resource of notions (ideas) in the human mind (brain), out of which we form inferences (truths) about nature as a whole and about its parts, are only the images of natural phenomena reflected in our brain, through our organs of senses. Out of these images, after a relevant interpretation, we can create relevant scientific facts (notions) - SF (SN), which are the initial scientific resource.

Scientific facts have irresistible strength of proof, similar to that of Archimedes' point of support, because their beginning (the root) is in the experimental data, and this fact is an expression of the logical necessity for the natural phenomena;

4) Science (theory) is not a mirror reflection of natural phenomena, but only their schematic image (model) by means of abstracted notions of the parts reality - nature. Depending on the purpose of a study, the abstracted (simplified) notions always reveal some flaw (incompleteness) relative to their relevant physical (chemical or biological) reality.

5) From point 4) the categorical statement (conclusion) follows, that every scientific theory (achievement) in a certain natural field is only the last but one word in this field. Which means that scientific advance is unlimited, i. e. it is boundless, because every new achievement can be followed by another one, which has been potential up to the moment, i. e. this is a mathematically endless process. This means that

SCIENTIFIC ADVANCE IS UNLIMITED – IT IS ENDLESS.

M.5. Inferences

5.1. According to the Big Bang theory, nature is in a perpetual motion (change); therefore, science (knowledge) and our ideas undergo an incessant development, too, and we should always be ready to replace one idea with another, a newer one, a more perfect one.

5.2. With advancement of science, our ideas about the fundamental laws become simplified and summarized, which, in fact, are its theoretical foundations presented as a simpler yet more perfect deductive groundwork.

5.3. *In doing this, the researchers' and scientists' ultimate task is to discover the primary initial laws (deductive groundwork), which, through a unitary approach from a common initial basis, will explain (describe) all natural phenomena (manifestations), and thus will unite all parts of physics into common, primary laws - theoretical foundations (logical groundwork).*

5.4. The purpose of this study, which is probably the first more comprehensive effort in this respect, is to formulate and develop the direction of physics based on the aspects resulting from the Big Bang, which is the historical expression of the genetically common outset of natural (world) evolution and simultaneously is the initial scientific resource for research and formulation of the theoretical foundations of the science about the Universe, treated as one whole – which theoretical foundations are herein called principal, as well as its details, which are subjects of specialized sciences – a component of the unitary science about nature – called naturology.

M.6. On the dual roles of the notions of space and time

6.1. Introductory thoughts

Every material object (process, phenomenon) is characterized by the notions of space and time in two aspects (roles):

a) as a quantity of volume (extension) in space and as a quality of duration

(durability);

b) as coordinate parameters (properties) of an object, which is not a direct carrier of its essential (substantial) properties, they are necessary for its mathematical description, for a specific identification (localization) of order by place in space and in chronological order of specific states in time, in relation to a randomly chosen reference point (reference coordinate system) agreed upon in advance. Because of this the quantitative values of the coordinate properties are multivariate, but this does not influence the essence and quality of real properties, which are described in preceding point a).

That is exactly why, in this sense, the coordinate properties of space and time do not directly depend on the substantial essence of matter (objects), but are unthinkable outside matter.

c) by means of relevant mathematical operations, most often through difference between coordinate parameters or only through difference between the coordinates, we derive the quantitative values of extension or durability. For example:

C.1. In spatial coordinates, relative to a random reference point *i*, for beginning r_{i1}, and end r_{i2} of a rod, the real length is

a) $r_{12} = r_{i1} - r_{i2} = inv$; b) $r_{i1} = \text{var}$; c) $r_{i2} = \text{var}$; (M.6-1)

C.2. In coordinates of time, relative to a random reference point j, for beginning t_{j1} of time of motion and t_{j2} for the moment when the object stops moving, the motion has lasted for time

a) $t_{12} = t_{j1} - t_{j2} = cnv$; b) $t_{j1} = \text{var}$; c) $r_{i2} = \text{var}$ (M.6-2)

C.3. Here is valid the formulation that coordinate notions of space and time, as numerical values are random as long as their reference point (the beginning) is randomly chosen and that is why they vary ($r_i = \text{var}$; $t_j = \text{var}$), but the real spaces and time defined by them are invariant (i. e. independent of the choice of reference point $r_{12} = inv$ and $t_{12} = inv$).

6.2. Interpretations

In the above meaning the coordinate notions of space and time are idealizations in meaning of numerical values (sizable notions) of the real extension and durability, determined relative to a randomly chosen convenient reference point – referential coordinate system - RCS, for the mathematical description of a given object and its manifestations.

In this sense, coordinate notions are not carriers of any matter in material or field form, but they are unthinkable out of matter in nature.

From the above definition it can be argued that

- space is homogenous and isotropic and that it does not interact with matter, *but matter influences it only by its inalienable property, extension.*
  And when we take into consideration the presence of matter in the form of gravitational field, because in nature there is no place without matter or without gravitational field respectively, it interacts with the rays of light and distort their trajectory, but they do not distort space, as it is sometimes

argued. In this sense the notion of homogenous and isotropic spatial continuum is supported, which is carrier of the notion coordinate space - coordinates.

– Time registers and, in a chronological aspect, makes meaningful the sequence, agreed upon as a sequence of static states, which are interpreted by the notion of incessant change or motion of objects, in the process of their evolution, as a result of their perpetual interaction.

To measure the changes of objects from one into another state, the cycles *n* are measured of an object chosen as a measuring standard, which has regular cycles of motion (radiation) with a unit of time interval T_0, which is a standard for the measurement unit of time.

This is how a homogenous and linear change of the time of the standard is obtained.

In this sense, the physical notion of coordinate time from one to another state of the object is measured by the coordinate time for *n* cycles.

$$t = n.T_0 ; \qquad \text{(P-5)}$$

The aspect that evolution of matter has no beginning and no end imlpies that time as a parameter of matter has also no beginning and no end, i. e. it is eternal.

M.7. Methodological principles

7.1. Introduction

In science, there is no algorithm for creation of theories. There is only a firm and unconditionally established criterion for their reliability, which is that they must be experimentally validated. Therefore, the categorical conclusion is: ***in order to be recognized as true, a scientific theory must have experimental validation of its initial claims and its final inferences.***

7.2. In scientific studies there is a system of methodological principles, which are a "peculiar aspect" of the algorithm for deriving veracious truths (regularities) about the studied objects, which are:

I. Methodological principle of observability - MPO

MPO is an updated expression of the ancient philosophical formulation that scientific facts, SF, are created from the images of natural phenomena reflected, through our senses, in human mind (brain) and interpreted afterwards. An aggregate of SF creates the initial resource, the premises, and out of them, through mental processes, are generated adequate inferences - inferences of the rank of reliable truths (laws).

Hereto belongs also the resource of initial information (facts) gained through various mental activities (education, literature, etc.). Observation is the genetic connection of reality with the knowledge about reality in human mind.

II. Methodological principle of veracity - MPV

MPV is an updated expression of the ancient thesis that truth is only that statement (thought), which has its analog (prototype) in nature (world). I. e. the criterion of truth is an expression of some material manifestation (body, phenomenon, property, process, etc.), which is an element (part) of the nature and which can be perceived (registered) directly or indirectly through our perceptions (observation). **In other words, truth is only that statement (thought), which is a fact (natural manifestation),** which directly or indirectly has a reflected image in human mind or interaction between the images in human mind.

III. Methodological principle for conservation of the tandem matter - energy - MPCME

As it has been pointed out, the notion of matter is conceptual, but in practice, when using it in specific sciences, it substantiates into something specific, real, which is eternal (indestructible and increatible) in time and space, alongside with the irreversible and inalienable from itself property of energy. In this sense herein we define the notion of material energy tandem, i. e. a unity between matter and energy. In the section of dynamics of physics, instead of the notion of matter is used idealization (abstraction) in the notion of mass, and so is it used most often in other sciences as well. Therefore, we shall further write of a tandem between mass and energy.

$$T_{(\mathrm{m_i}-\mathrm{w_i})} = T_{(\mathrm{m_j}-\mathrm{w_j})} = T_0 = const.; \qquad \text{(M.7-1)}$$

Here is given the mathematical expression for the transition of the tandem from state $i - T_{(\mathrm{m_i}-\mathrm{w_i})}$ into state $j - T_{(\mathrm{m_j}-\mathrm{w_j})}$, and the relevant consequences are:

$$\text{a)}\ \sum m_{\mathrm{i}} = \sum m_{\mathrm{j}} = const.;\ \text{b)}\ \sum W_{\mathrm{i}} = \sum W_{\mathrm{j}} = W_0 = const.; \qquad \text{(M.7-2)}$$

or

$$c^2.\sum m_{\mathrm{i}} + \sum W_{\mathrm{i}} = c^2.\sum m_j + \sum W_{\mathrm{j}} = T_0 = const.; \qquad \text{(M.7-3)}$$

This MPCME is actualization of the ancient philosophical principle of eternity (conservation, increatibility and indestructibility) of matter.

THIS PRINCIPLE IS UNCONDITIONAL AND OBLIGATORY WHEN DESCRIBING ALL MANIFESTATIONS OF MATTER AND ALONGSIDE WITH THE PRINCIPLE OF HOMOGENEITY OF THE MEMBERS OF THE EQUATIONS IS A CRITERION FOR RELIABILITY IN MATHEMATICAL DESCRIPTION OF ANY MATERIAL INTERACTION.

IV. Methodological principle of incessant interaction - MPPI

This principle is an expression of the ancient philosophical principle of transience, i.e. that in nature everything changes all the time (perpetually) – EVERYTHING FLOWS.

In essence, the fundamental principle (law) of interaction characterizes by the fact that between the fragments of material continuum exists a permanent exchange and conversion of various quantities of the mass energy tandems of fragments. This exchange results into conversion (performance of work) of the quantities of tandems of objects

(fragments) and of the structures and their organizations from one into another form (structure). *This change from one into another form (state), as a process of conversion, is called work (performance of work), as a result of which properties transform,* **i.e. the fragments after interaction assume new properties. The process of interaction in its sense and by its results is also a process of self-organization (reorganization) of realities.**

If in a closed system, there are $L = N + K$ objects (realities) out of which N – give off, and K – take in (absorb) tandems (matter - energy), then the mathematical expression of MPPI for states *i* and *j* is:

$$\text{a)}\ \sum_{1}^{N} T_{(m_i - w_i)} + \sum_{1}^{K} T_{(m_i - w_i)} = 0\ ;\ \text{b)}\ \sum_{1}^{N} T_{(m_i - w_i)} + \sum_{1}^{K} T_{(m_i - w_i)}\ ; \qquad \text{(M.7-4)}$$

In the pattern of Newton's mechanics (classical mechanics), the quantity of energy that is released (tandem) is called action (force), and that which is taken in - counteraction (counterforce). In this sense, in interaction there is action and counteraction.

The mechanism of interaction can also explain the mechanism of transition from the quantitative into qualitative relations.

Finally, the process of interaction also changes the material resources of fragments. As a result of their change, because it takes place inside the system, without any external interference, it is also a self-organization (self-evolution). In such an aspect, the fragments can lose more properties than these which they receive as new ones. This process is called degradation of the fragment.

The opposite process, when the new properties are more than the lost ones, the process is called progressive or it is simply said that there is evolution.

V. Methodological principle of formal logic - MPFL

MPFL has been known since ancient times; that was the name of Aristotle's logic for deriving new truths through interpretation, using the laws of logic, of a system of known truths called - PREREQUISITE.

This principle is an expression of the experimental data, that the whole is more (has more properties) than the arithmetic sum of the properties of its separate parts, considered as independents objects. **I. e. new truths are derived (deduced) out of a prerequisite representing a system of several truths, after conducting a study (interpretation).** Or out of the system of truths considered **as one whole and called prerequisite**, *after interpretation are also derived truths which are new relative to these which are input in it as initially known truths.* **In such an aspect, MPFL has its root in MPCME, i. e. that out of nothing it is impossible to create anything real. AND APPLIED TO SCIENCE IT SAYS THAT NEW TRUTHS CAN ONLY BE DERIVED FROM KNOWN TRUTHS (PREREQUISITES) THROUGH INTERPRETATION VIA THE LAWS OF MATTER – THE LAWS OF LOGIC.**

When applying MPFL, it is necessary:

First. Unconditionally and obligatory, the prerequisites must be reliable truths (experimentally validated) about natural phenomena.

Second. The interpretation is made only through the laws of logic, which are deduced from natural phenomena – from experimental data.

Third. *The inferences – the new truths, must have experimental (material) validation and only after that can they achieve a status of reliable truths.*

VI. Methodological principle of simplicity - MPS

This principle is also called Occam's razor. It requires that a minimal number of known truths should be used when formulating prerequisites in MPFL.

Or out of several theories, which explain a phenomenon equally well, the most perfect (the most reliable) is the one which has the least initial assumptions.

Chapter one
Basic laws of physics

1.1. Introduction

The unitary science of nature, naturology, which has a homogenous resource (homogenous substance), requires that this science should be based on the following initial genetic grounds:

First. Homogenous genetic essence of all the diverse natural phenomena (objects, manifestations, processes, etc.), i. e. nature should be viewed as a homogenous genetically integral entity.

Second. The diversity of genetically homogenous natural phenomena is structurally conditioned, i. e. by the facts that they have:

- structural elements of different structures, but of homogenous substance;
- structural elements of different locations, but of identical quantity and identical properties;
- structural elements of different quantity (number), but identical properties;
- structural elements of different quantity and structure, but of homogenous substance.

Third. In general, the natural diversity is structurally conditioned by homogenous substance both at the level of structural elements and at the level of natural phenomena.

1.1.1. On the notion of force

According to Isaac Newton, energy dW is measured through work $dA = \vec{F}.d\vec{r}$, which is equal to the product of force $\vec{F}$ by distance (pathway) $d\vec{r}$. The mathematical notation of this definition is:

$$\text{a) } dA = \vec{F}.d\vec{r} = dW = \vec{v}.d.\vec{P}\text{; b) } \vec{F} = \frac{dW}{dr}\vec{r}_0 = \frac{\vec{v}.d\vec{P}}{v.dt} = \frac{d\vec{P}}{dt};$$

$$\text{c) } d\vec{r} = \vec{v}.dt\text{; } \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}; \qquad (1.1\text{-}1)$$

Id est, force F is equal to the quantity of energy $W_F = F$, which is conveyed from one body to another in interaction along a unit of distance (pathway) ($r = 1$). Such interpretation of the force results from its dimensionality as well:

$$\text{force} - \text{F} \rightarrow [N] = \left[\frac{J}{m}\right] \rightarrow [NewtonN] = \left[\frac{Joule - J}{meter - m}\right]; \qquad (1.1\text{-}2)$$

Or, by applying the dependence of energy W on mass m - (M.2-1).

$$\text{a) } W = M.c^2\text{; b) } [J] = [kg]\left[m^2.s^2\right]; \qquad (1.1\text{-}3)$$

to force F, we obtain that *the force is carrier of mass*

$$force - \text{a) } F = \frac{dW}{dr} = \frac{dM}{dr}.c^2; \rightarrow \text{b) } [N] = \left[\frac{J}{m}\right] = \left[\frac{M_F}{\text{m}}\right].c^2; \rightarrow$$

c) $M_{\mathrm{F}} = \dfrac{F}{c^2};\rightarrow \left[J.m^{-3}.s^2\right];$ $\qquad (1.1-4)$

Evidently, force is the energy that one body releases (exchanges with) to another in interaction between bodies. Along a unit of pathway of the interaction (or the force) the force also gives off mass, which corresponds to the energy as per equation *(1.1-3)a*. ***I.e. force always releases energy and mass, and that is why the energies and masses of bodies always change after force interaction.***

1.2. On the model of study of the kinetic energy

Since every material object is part of the common unitary material resource of nature, then an object, on the one hand, is carrier of its specific properties, and on the other hand, it is also irrevocable carrier of the common properties of the unitary resource, in which whey are unconditionally included: its energy and mass, as well as its relation with the fields, which are its field resource. **At present, the simplest yet still unknown structure is the one of the structural elements of unknown substantial nature out of which are formed the electrons (the electron of electric charge $q_{\mathrm{e}} = 1{,}6.10^{-19} C < 0$ and the positron - $q_{\mathrm{e}} = 1{,}6.10^{-19} C > 0$. That is why electrons are the most appropriate model to study the physical manifestations of nature.** Similarly too, Einstein, in [1] in §10, accepts the electron as a model of the properties of bodies when computing the mass and kinetic energy of bodies, which is evident from the following citations in [1]:

a) In [1]* (paragraph 10), in the conclusion from the formulae of the masses of an electron, Einstein writes: *"Let assume that a point-like particle with electric charge q_{e} (which hereafter will be referred to as electron) moves in electromagnetic field".. "for an interval of time, the electron reaches velocity v".* After computations, using electrodynamics and Lorentz transformations, he gives the formulae of the masses of electrons

a) longitudinal mass = $\left[\left(1-\dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}\right]^{-\frac{3}{2}}$;

b) transverse mass = $m_{\mathrm{e0}}\left(1-\dfrac{v^2}{c^2}\right)^{-\frac{1}{2}}$; $\qquad$ (1.1-5)

и goes on: *"... we should note that these results for the masses hold true for neutral points too, because if a randomly small charge joins such a material point, it turns into electron (в our sense)."*

b) In [1] (§10) Einstein writes: *"Let we determine the kinetic energy of electron"* and after relevant computations, he gives the formula of the kinetic energy in the

* [1]A. Einstein Zur Elektrodynamic der bewegter körper Ann.d.Rhis. 1905.17.821-921

form:

$$W_{\mathrm{ke}} = m_{\mathrm{eo}}.c^2\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right]>0\,; \qquad (1.1\text{-}6)$$

If in these formulae (1.1-6) and in (1.1-5) m_{eo} is replaced with the formula (1.3-3), which is from the next paragraph, we have

a) $m_{\mathrm{eo}} = (\pm q_{\mathrm{e}}).k_{\mathrm{e}}.\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}>0\,;$

b) $W_{\mathrm{ke}} = (\pm q_{\mathrm{e}})^2.k_{\mathrm{e}}.c^2\left[\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}-1\right]>0\,]$ (1.1-7)

by which it becomes evident *that the masses* m_{e} *and the energies* W_{ke} *depend on the square of the electric charges of the electron and positron, i. e. they are electromagnetic and only positive.*

In [1] (paragraph 10) after the formula (1.1-5) Einstein writes: *"this expression of kinetic energy should hold true for any mass because of the argument given above"* (he referred to the argumentation offered for the masses (1.1-5), P.P.'s note). This is the reason why in interpreting issues of kinetic energy it is the electron and its properties that are used as a model, and they, according to Einstein, are properties of the bodies (objects), for the formulae (1.1-5) and (1.1-6) are validated by experiment as well. *These are formulae from the special theory of relativity, which will be deduced in the next paragraph 1.3. without the assumptions of the theory of relativity.*

1.3. Kinetic energy of electrons

1.3.1. General assumption about electrons

Electrons generate electrostatic, magnetic and gravitational fields, which are characterized by density of energies and masses, and electrons are one whole made of energies and masses.

1.3.1.1. Electrostatic field, energy and mass of the electron

At distance $\vec{r}$ from the electron, there is electrostatic field

$$E = \frac{q_{\mathrm{e}}.\vec{r}_0}{4\pi\varepsilon_0 r^2}\,;\ \vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}\,; \qquad (1.3\text{-}1)$$

where: ε_0 is the dielectric constant of vacuum.

The electrostatic field has density of its energy and mass

a) $w_{\mathrm{e}} = \frac{\varepsilon_0 E^2}{2}$; b) $\rho_{\mathrm{E}} = \frac{w_{\mathrm{E}}}{\mathrm{c}^2}\,;$ (1.3-2)

and the electrostatic energy W_{eE} and mass m_{e0} of the electron at rest are:

a) $E_{eE0} = \int_{r_{e0}}^{\infty} w_e dV = \frac{q_e^2}{4\pi\varepsilon_0 r_{e0}}$; b) $m_{e0} = \frac{q_e^2}{4\pi\varepsilon_0 r_{e0} c^2} = q_e^2.k_e$;

c) $k_e = \left(4\pi\varepsilon_0 r_{e0} c^2\right)^{-1}$; (1.3-3)

where: r_{e0} is the computational (classical) radius of the electron; V - volume.

1.3.2. Magnetic field and magnetic (kinetic) energy of the electron at velocity $v << c$.

At velocity $v \neq 0$, around the electron is generated magnetic field

$$\vec{H} = \varepsilon_0\left[\vec{v}.\vec{E}\right] = \frac{q_e}{4\pi r^2}\left[\vec{v}.\vec{r}_0\right] = \frac{q_e.\vec{a}}{4\pi r^2}\left[\vec{a}_0.\vec{r}_0\right];\ \vec{a}_0 = \frac{\vec{a}}{|\vec{a}|}; \quad (1.3\text{-}4)$$

the density of the energy of w_H and the mass ρ_H

a) $w_H = \mu\frac{H^2}{2}$; b) $\rho_H = \frac{w_H}{c^2}$; $\mu_0 = \frac{1}{\varepsilon_0 c^2}$; (1.3-5)

The generation of magnetic field, respectively of magnetic energy of the electron results from (is at the expense of) the energies passed by the forces of interaction of the external electric $\vec{E}_B$ and gravitational $\vec{G}_B$ fields

a) $\vec{F}_e = q_e.\vec{E}_B = \frac{d\vec{P}_e}{dt} = \frac{d\left(m_e.\vec{v}\right)}{dt}$; b) $\vec{F}_G = m_e.\vec{G}_B = \frac{d\vec{P}_e}{dt} = \frac{d\left(m_e\vec{v}\right)}{dt}$ (1.3-6)

because they render acceleration $\vec{a}_e$, velocity $\vec{v}_e$ and momentum $\vec{P}_e = m_e.\vec{v}_e$ of the electron

a) $\vec{a}_e = \frac{\vec{F}}{m_{e0}}$; b) $\vec{v} = \vec{a}_e.t = \frac{\vec{F}}{m_{e0}}.t$; (1.3-6)

Here we should emphasize the following points:

First. Because the dimensionality of the force is $\vec{F} \rightarrow [\text{джаул / метър}] = \left[J.m^{-1}\right]$, its essence is the energy passed from the external fields E_B and G_B of the electron, which energy is converted into magnetic field, respectively magnetic energy of the electron.

Second. The mass of the electron m_e is the gravitational charge for gravitational field G, similarly to (1.3-6)a of q_e relative to E_b.

Third. Forces generate: acceleration, velocity and momentum of the electron for time dt respectively along distance $d\vec{r} = \vec{v}.dt$, in the process of interaction of the external fields with the electron (q_e, m_e), forces $\vec{F}_e$ and $\vec{F}_G$ render energy dW_e to the electron

a) $dW_e = \vec{F}_e.d\vec{r} = \vec{F}_G.d\vec{r} = \frac{dP_e}{dt}.d\vec{r} = \vec{v}.d\vec{P} = \vec{v}.\left(m_e.\vec{v}\right)$ (1.3-8)

Since W. Kaufmann experimentally proved in 1901 that the mass m_e of the electron is a variable function of velocity, this experimental result should be reflected

in the derivative of $\vec{P}_e$, respectively through the force

$$\vec{F} = \frac{d\vec{P}_e}{dt} = m_e.\frac{d\vec{v}}{dt} + \vec{v}.\frac{dm_e}{dt}; \qquad (1.3\text{-}9)$$

And out of the force (1.3-9) is the energy dW_e

$$dW_e = \frac{1}{2}.m_e.d\left(v^2\right) + v^2.dm_e; \qquad (1.3\text{-}10)$$

From dW_e (1.3-11) is derived the differential of the mass*

$$dm_e = \frac{dW_e}{c^2} = -\frac{1}{2}m_e.d\left(\frac{v}{c}\right)^2 + dm\left(\frac{v}{c}\right)^2 = \frac{1}{2}.m_e.d\left(1-\frac{v^2}{c^2}\right) + dm_e.\left(1-\frac{v^2}{c^2}\right);$$

$$(1.3\text{-}11)$$

Or, processing (1.3-11), we obtain the equation

$$\frac{dm_e}{m_e} = -\frac{1}{2}.\frac{d\left(1-\frac{v^2}{c^2}\right)}{\left(1-\frac{v^2}{c^2}\right)} = -\frac{1}{2}.\frac{d\left(1-\beta^2\right)}{\left(1-\beta^2\right)};\ \beta = \frac{v}{c}; \qquad (1.3\text{-}12)$$

The solution is subject to the following boundary conditions:

a) $v = 0;\rightarrow$ b) $m_e = m_{e0}$; c) $v \neq 0 \rightarrow d)m_e = m_e$; (1.3-13)

From solution (1.3-11) we derive the dependences of the full mass and energy of the electron at $v \neq 0$

a) $m_e = m_{e0}\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}$; b) $W_e = m_e.c^2 = W_{e0}.\left(1-\frac{v^2}{c^2}\right)^{-\frac{1}{2}}$;

c) $W_{e0} = m_{e0}.c^2$; (1.3-14)

where: W_{e0} is the internal energy of the electron.

Only the magnetic energy and mass of the electron are equal to the differences of the full energy W_e (1.3-13)b and mass m_e (1.3-13)a minus the internal energy W_{e0}, and its relevant mass

a) $W_{HE} = W_e - W_{e0} = W_{e0}\left[\left(1-\beta^2\right)^{-1/2} - 1\right]$;

b) $m_{HE} = \frac{W_{HE}}{c^2} = m_{e0}\left[\left(1-\beta^2\right)^{-\frac{1}{2}} - 1\right]$. (1.3-15)

These values are at $v \neq 0$, but for practical computations, it is convenient to use them at high velocities, always less than c i. e. at $v < c$. And at velocities much less

---

* The dependence of the density of electromagnetic energy w on the density of mass $\rho - w = \rho.c^2$ was given by Maxwell in 1873

than c, i. e. at

$$\text{a) } v << c \text{ ; } \rightarrow \text{b) } \frac{v}{c} << 1 \text{ or c) } \frac{v}{c} \rightarrow 0; \tag{1.3-17}$$

The function $\left(1-\beta^2\right)^{-1/2}$ is developed into power series

$$\left(1-\beta^2\right)^{-1/2} = 1+\frac{1}{2}\beta^2+\frac{3}{8}\beta^4+\frac{15}{18}\beta^6 ... \tag{1.3-18}$$

With sufficient preciseness, at $v << c$ we derive magnetic energy W_{He} of the electron by taking only the first two terms of the series (1.3-18) and we obtain

$$W_{\text{He}} = W_{\text{e0}}\left[1+\frac{1}{2}\beta^2-1\right] = W_{\text{e0}}\cdot\frac{1}{2}\cdot\frac{v^2}{c^2} = m_{\text{e0}}.r^2\,\frac{1}{2}\cdot\frac{v^2}{c^2} = \frac{m_{\text{e0}}v^2}{2} = W_{\text{ke}} \tag{1.3-19}$$

This expression of magnetic energy of the electron at $v << c$ is called kinetic energy. Corresponding to it is also the mass of magnetic energy

$$\text{a) } m_{\text{He}} = W_{\text{He}}\Big/c^2 = \frac{m_{\text{e0}}.v^2}{2.c^2} << m_{\text{e0}} \text{ ; b) } \frac{v^2}{c^2} << 1 \text{ ;} \tag{1.3-20}$$

Owing to which the sum of the mass of the electron m_{e0} (1.3-3)b and m_{He} is

$$m_{\text{e}} = m_{\text{e0}} + m_{\text{He}} \approx m_{\text{e0}} = const. \text{ ;} \tag{1.3-21}$$

i. e. because $m_{\text{He}} << 1$ drops off and computations are done only at m_{e0}.

In this sense kinetic energy in essence is the magnetic energy of the electron, which is a material form of electromagnetic matter.

I. e. the magnetic energy and mass of the electron in their essence are given in J. C. Maxwell's "Treatise on electricity and magnetism" of 1873, paragraph 638, where it reads: "we should consider both magnetic and electromagnetic energies as kinetic energies".

The results obtained above coincide with these from the special theory of relativity, but they are deduced only on the basis of the classical electrodynamics of Maxwell of 1873, by using only Galileo's transformations described by Isaac Newton in 1687. And because they are obtained from less initial premises (outside the postulate of constancy of the velocity of light and outside Lorentz transformations), *according to the principle of simplicity (Occam's razor), they are more perfect, and therefore this approach is more reliable. And* **because they explain the gain of the mass of the electron by the gain of the mass of its magnetic energy and offer a profound analysis, then this solution is the preferable one, for it *simplifies the physical laws and explains the physical meaning of the gain of mass.***

1.4. Emission of electromagnetic energy of electrons in the form of electromagnetic waves at velocity *c*

1.4.1. In collision of an electron onto a hard surface

According to electrodynamics, during the motion of electrons of acceleration $\vec{a}$, they emit power

$$N = \frac{dW}{dt} = \frac{q_e^2.a^2}{6.\pi.\varepsilon_0.c^3}; \qquad (1.4\text{-}1)$$

In collision of an electron of velocity v_0 onto a hard surface and its absorption by it, its velocity becomes equal to zero. If the duration of the collision is τ, the mean acceleration of the electron is:

$$\vec{a} = \frac{\vec{v}_0}{\tau}; \qquad (1.4\text{-}2)$$

Provided that distance r_a, at which the velocity v_0 becomes zero, is equal to the diameter of the electron $r_0 = D_{e0} = 2.r_{e0}$, and the velocity $v_0 = 10^6 m.s^{-1}$ the time is:

$$\tau = \Delta t = \frac{r_0}{v_0} = \frac{D_{e0}}{v_0} = \frac{5.62.10^{-15}}{10^6} = 5{,}62.10^{-21} s; \qquad (.1.4\text{-}3)$$

At a velocity of the electron v_0 of the order of the velocities of electrons in the atom $v_0 \approx 10^6 m.S^{-1}$ и $r_{eo} = 2.81.10^{-15} m$ and the acceleration at the collision is:

$$a = \frac{v_0}{\tau_{e0}} = \frac{10^6}{5{,}62.10^{-15}} \approx 1{,}77.10^{27} m.s^{-2}; \qquad (1.4\text{-}4)$$

From formula (1.4-1) by replacing the participating quantities with numerical values and multiplying by time τ, we derive the emitted wave energy:

$$\Delta W = N.\tau = 9{,}98.10^{-18} J; \qquad (1.4\text{-}5)$$

which is of the order of the energy of a photon of frequency $\nu = 10^{16} Hz$ (in the ultraviolet spectrum), which is:

$$W_e = h.\nu = 6{,}625.10^{-34}.10^{16} = 6.625.10^{-18} J; \qquad (1.4\text{-}6)$$

the accepted velocity $v_0 = 10^6 s^{-2}$ is of course only tentative.

Velocities $v_0 = 10^2 \div 10^3 m.s^{-1}$, result in $a = 1{,}77\left(10^{23} \div 10^{24}\right) m.s^{-2}$ and $\Delta W = 9{,}98.\left(10^{-26} \div 10^{-24}\right) J$, and in frequency of photons of $\nu = 9{,}98\dfrac{\left(10^{-26} \div 10^{-24}\right)}{6{,}625.10^{-34}} = 1{,}5\left(10^8 \div 10^{10}\right)$. Hz

With regard to the emission of energy from the electrons in connection with the direction of the velocity of the electron $\vec{v}_e$ and the direction of the acceleration $\vec{a}_e$, which is determined by the direction and value of the acting force $\vec{F}_d = m.\vec{a}$, where m_e is the mass, connected with the force of electrons m_e, where the acceleration of the electron is:

$$\vec{a}_e = \frac{\vec{F}_d}{m_e}; \qquad (1.4\text{-}7)$$

Here, the following rule holds true:

The projection of the acceleration $\vec{a}_e$ *upon velocity* v_e *of the electron* $\vec{a}_{ea}$ *is called active, because only when* $\vec{a}_{ea} \neq 0$ *the force* $\vec{F}_d$, *which generates this acceleration, has a projection* $\vec{F}_{da} \neq 0$ *upon the velocity* $\vec{v}_e$ *of the electron. And* **only the product of the elementary part of the trajectory of the electron**

$$d\vec{r}_e = v_e.dt \; ; \qquad (1.4\text{-}8)$$

multiplied by the force $\vec{F}_{da}$ is different from zero, i. e.

$$dW_e = \vec{F}_{da}.d\vec{r}_e = F_{da}.dr_e.\cos 0 \neq 0 \; ; \qquad (1.4\text{-}9)$$

Id est only on condition (1.4-9,) the force acting on the electron $\vec{F}_{da}$, *which moves at velocity* $\vec{v}$, *releases it a real value of energy* dW_e *to it.* And depending on the sign of this energy $dW_e >< 0$, it accelerates ($\vec{v}_e$ increases) or slows down ($\vec{v}$ decreases) the electron. Or, in other words, depending on the sign of dW_e (1.4-9), the kinetic energy of the electron increases or decreases.

If the projection of the acceleration $\vec{a}_e$ **upon the velocity** $\vec{v}_e$ **is zero (i. e. the acceleration is perpendicular to** $v_e - \vec{a}_e \perp \vec{v}_e$**), then the acceleration is passive -** $\vec{a}_{ep}\left(\vec{a}_{ep} \perp \vec{v}_e\right)$**. In this case** dW_e **is:**

$$dW_e = \vec{F}_{dp}.d\vec{r}_e = F_{dp}.dr_e.\cos\frac{\pi}{2} = 0 \; ; \qquad (1.4\text{-}10)$$

Id est in case $\vec{a}_{ep} \perp \vec{v}_e$, the force $\vec{F}_{dp} = m.\vec{a}_{er}$ is perpendicular to the velocity of the electron, too, and because of this it does not give off energy to the electron, **owing to which the electron does not change its energy, and thus the force** $\vec{F}_{de}$**, respectively acceleration** $\vec{a}_{ep}$**, changes only the direction of its velocity.** For example, if the electron is in the orbital of the atom, at this force (acceleration), the electron will move constantly only along one orbital – it will neither fall down onto nucleus, nor move up to a higher orbital.

1.5. Emission of photons by electrons in atoms

1.5.1. General assumptions about the emission and absorption of photons

1. The electron has electric charge $q_e = -1{,}6.10^{-19} C$.

2. The mass of the electron at the velocity in the orbital of the atom is

$$at\, v_e \approx 10^6 m.s^{-1} << c \rightarrow m_{e0}\left(1 - 1{,}11.10^{-4}\right) \approx m_{e0} = q_e^2.k_e : k_e = \left(4\pi\varepsilon_0.r_{e0}.c^2\right)^{-1} \qquad (1.5\text{-}1)$$

3. In the atom of hydrogen, its nucleus has charge $q_я = -q_e = +1{,}6.10^{-19} C$.

4. The electric potential V_e and the potential energy W_{ep} of the electron, which is in the orbital at distance $r_e = n^2.r_0$,

a) $r_e = n^2.r_E$; b) $n = 1; 2; 3...integer$; (1,5-2)

where: r_0 is the lowest value of the radius of the electron in the atom, and then:

a) $V_e = \frac{q_e}{4.\pi.\varepsilon_0.r_e}$; b) $W_{ep} = \frac{q_e.q_я}{4.\pi.\varepsilon_0.r_e}$; (1.5-3)

which are quantized, because they are functions of q_e and $q_я$, which are quantized electric charges, because q_e is the smallest quant (quantity) of electric charge, or from (1.5-3) the result is

a) $q_e = V_e.4\pi.\varepsilon_0.r_e$; b) $q_e.q_я = W_{ep}.4\pi\varepsilon_0.r_e$; c) $r_e = n^2.r_0$; (1.5-4)

From (1.5-4), it is evident that the distances r_e should also be quantized.

5. The force – Coulomb's law is a derivative of W_{ep} relative to r_e

$$F_k = F_e = \frac{dW_{ep}}{dr}.\vec{r}_0 = \frac{q_e.q_я.\vec{r}_0}{4\pi.\varepsilon_0.r_0^2}\ ;\ \vec{r}_0 = \frac{\vec{r}_e}{|\vec{r}_e|}\ ; \quad (1.5\text{-}5)$$

6. From (1.5-4) the energy

a) $dW_{ep} = \vec{F}_k.d\vec{r}$; b) $W_{ep} = -\int_{\infty}^{r_e} \frac{q_e.q_я.\vec{r}_0.d\vec{r}_e}{4\pi.\varepsilon_0.r_e^2} = \frac{q_e.q_я}{4\pi.\varepsilon_0.r_e} = \frac{q_e.q_я}{4\pi.\varepsilon_0.n^2.r_0}$;(1.5-6)

therefore, the force F_k is quantized as well.

7. The full energy W_n of the electron in the atom atvelocity v_e is a sum of the potential energy W_{ep} and the kinetic (magnetic) $W_k = \frac{m_{e0}.v_e^2}{2}$ energies

$$W_n = W_{ep} + W_k = -\frac{q_e^2}{8\pi.\varepsilon_0.r_n}\ ;\ r_n = n^2.r_0\ ; \quad (1.5\text{-}7)$$

It is evident from (1.5-7) that the full energy of the electron in the atom is quantized, too.

8. Forces and energies during absorption and emission of a photon with energy W_f and mass $m_f = W_f / c^2$ of the photon.

A hydrogen atom is interpreted; whose full energy in stationary mode is W_n (1.5-7).

In stationary mode, the electron moves along a stationary orbital with $r = r_n = const.$ owing to which the centripetal $\vec{F}_c$ and centrifugal $\vec{F}_j$ are numerically equal, but with opposite directions, i. e.

a) $\vec{F}_i + \vec{F}_j = 0\ ; \rightarrow$ b) $|\vec{F}_i| = |\vec{F}_j| = F_n\ ;$ (1.5-8)

Forces $\vec{F}_i$ and $\vec{F}_j$ are derivatives of their energies W_n and W_k ; therefore, their energies are equal as well

a) $W_{ep} = W_k\ ; \rightarrow$ b) $\frac{q_e^2}{4\pi.\varepsilon_0.r_n} = \frac{m_{e0}.v^2}{2}$; (1.5-9)

therefore, the radius is

$$r_n = \frac{q_e^2}{4\pi.\varepsilon_0.m_{e0}.v_e^2} = n^2.r_0 \; ; \qquad (1.5\text{-}10)$$

And the values of forces $\vec{F}_i$ and $\vec{F}_j$ or F_n are

$$F_n = \left|\vec{F}_i\right| = \left|\vec{F}_j\right| = \left|\frac{dW_n}{dr}.\vec{r}_0\right| = \left|\frac{\vec{v}_e.d\vec{P}_e}{v.dt}\right| = \left|\frac{d\vec{P}_e}{dt}\right| = \left|m_{e0}.\frac{d\vec{V}_e}{dt}\right| = \left|m_{e0}.\vec{a}_n\right| ; \qquad (1.5\text{-}11)$$

To these forces correspond equal in values centripetal $\vec{a}_i$ and centrifugal $\vec{a}_j$ accelerations, which have opposite direction

a) $\left|\vec{a}_i\right| = \left|\vec{a}_j\right| = \left|\vec{a}_n\right| = \left|\frac{v_n^2}{r_n}.\vec{r}_0\right| = \left|-\omega^2.r_n\right|$; b) $\vec{a}_i + \vec{a}_j = 0$;

c) $\omega = 2\pi.\nu$; d) $v_n = \omega.r_n$; e) $\vec{r}_0 = \frac{\vec{r}_n}{\left|\vec{r}_n\right|}$; $\qquad (1.5\text{-}12)$

where: ω is the angular frequency of the electron at radius of the orbital - r_n; ν - the frequency of the revolutions of the electron along the orbital with r_n.

9. In stationary mode, the accelerations $\vec{a}_i$ и $\vec{a}_j$ are perpendicular to the velocity v_n of the electron upon the orbital with radius r_n, i. e.

a) $\vec{a}_i \perp \vec{v}_n$; b) $\vec{a}_j \perp \vec{v}_n$; $\qquad (1.5\text{-}14)$

Therefore, the forces $\vec{F}_i$ and $\vec{F}_j$ are perpendicular to the velocity $\vec{v}_n$ as well, i. e.

a) $\vec{F}_i \perp \vec{v}_n$; b) $\vec{F}_j \perp \vec{v}_n$; $\qquad (1.5\text{-}14)$

because

a) $\vec{F}_i = m_{e0}.\vec{a}_i$; b) $F_j = m_{e0}.\vec{a}_j$; $\qquad (1.5\text{-}15)$

Because of this (1.5-15) and because $d\vec{r}_n = \vec{v}_n.dt$, the work, which they do or the energy needed to change the energy of the electron, is zero, i. e.

a) $dA_i = dW_i = \vec{F}_i.d\vec{r}_n = \vec{F}_i.\vec{v}_n.dt = F_i.v_n.dt.\cos\pi/2 = 0$;

b) $dA_j = dW_j = \vec{F}_j.\vec{v}_n.dt = F_j.v_n.dt.\cos\pi/2 = 0$; $\qquad (1.5\text{-}16)$

Because of this (1.5-16), the energy of the electron does not change in stationary mode and it constantly moves along the same orbital and does not fall down onto the nucleus. The reason for this is (1.5-16) that the sum of the attractive (centripetal) force $\vec{F}_i$ and the centrifugal force $\vec{F}_j$ in stationary mode mutually neutralize – their sum is zero (1.5-8)a.

This conclusion, which has also an experimental validation, and that disproves the claims that it does not result from classical physics, but is something new, a fact from the quantum mechanics. But as it is seen, it is a purely classical effect from the classical electrodynamics.

10. Therefore, in order to change the energy of an electron, which is in an atom

orbital and moves at velocity $\vec{v}_e$, it is necessary that the angle θ between the force $\vec{F}_i$, which acts upon it and its velocity v_e should be under an angle different from $\pi/2$, i. e.

$$\theta \neq \pi/2; \qquad (1.5\text{-}17)$$

or the acceleration $\vec{a}_i$ which is rendered to it should be under an angle θ different from $\pi/2$ relative to its velocity $\vec{v}_e$, so that the shift $d\vec{r}_n = \vec{v}_n.dt$ should not be perpendicular to force $\vec{F}_i$ and the product of $\vec{F}_i$ by $d\vec{r}_n$, which is equal to the work dA_i and the energy dW_i should be different from zero, i. e.

$$dA_i = dW_i = \vec{F}_i.d\vec{r}_n = \vec{F}_i.\vec{v}_n.dt = F_i.v_n.dt.\cos\theta \neq 0; \qquad (1.5\text{-}18)$$

In (1.5-18), two radically different solutions are possible depending on the value of the angle θ.

10.1. When the angle θ is less than $\pi/2$.

Then the force $\vec{F}_i$ (the acceleration $\vec{a}_i$) has a component (projection) $\vec{F}_i'$ ($\vec{a}_i'$) upon the direction of the velocity $\vec{v}_e$, owing to which it increases to $v_e' > v_e$, and along with it also increases the kinetic energy of the electron from W_k to $W_k' > W_k$. Since the sum of the kinetic W_k and the potential W_{ep} energies of the electron must remain constant, the potential energy, therefore, must decrease to $W_{ep}' < W_{ep}$, with a gain ΔW_k of the kinetic energy, and this means that the radius r_n of the orbital increases to $r_n' > r_n$ or, proceeding from (1.5-9), the result is

$$\text{a) } W_{ep}' = \frac{q_e^2}{4\pi\varepsilon_0.r_n'} = \frac{m_{e0}.v_e'^2}{2}; \text{ b) } r_n' = \frac{2.q_e^2}{4\pi\varepsilon_0.m_{e0}.v_e'^2} > r_n; \qquad (1.5\text{-}19)$$

i. e. at $\theta < \pi/2$ the electron moves to a higher orbital with $r_n' > r_n$, and its potential energy is lower.

Such is the case when the electron absorbs, from outside, a photon with energy

$$W_f = W_k' - W_k; \qquad (1.5\text{-}20)$$

10.2. When the angle θ is larger than $\pi/2$.

Then the projection of the force $\vec{F}_i$ (the acceleration $\vec{a}_i$) is upon the opposite direction of the velocity $\vec{v}_e$ of the electron, because of which the velocity $v_e'' < v_e$ decreases, and hence its kinetic energy decreases as well to $W_k'' < W_k$, and its potential energy $W_{ep}'' < W_{ep}$ increases, because of which the radius of its orbital decreases to $r_n'' < r_n$; by analogy to (1.5-19), for r_n'' it is obtained

$$r_{\text{n}}^{"} = \frac{2.q_{\text{e}}^2}{4\pi\varepsilon_0.m_{\text{e0}}.v_{\text{e}}^{"2}} < r_{\text{n}}\,; \qquad (1.5\text{-}21)$$

and has a kinetic energy $W_{\text{k}}^{"}$ and a potential $W_{\text{ep}}^{"}$ energy

$$\text{a) } W_{\text{k}}^{"} = W_{\text{k}} - W_{\text{f}} = \frac{m_{\text{e0}}.v_{\text{e}}^{"2}}{2}\,; \text{ b) } W_{\text{ep}}^{"} = \frac{q_{\text{e}}^2}{4\pi\varepsilon_0.r_{\text{n}}^{"}}\,; \quad (1.5\text{-}22|$$

The decrease of W_{k} of $W_{\text{k}}^{"}$ is by the energy of the photon W_{f}, which is emitted in this process 10.2 at $\theta > \pi/2$.

The setting forth contains the mechanisms of absorption and emission of photons.

Emphasis I. **The analyses in items 10.1 and 10.2 are made only through the laws of classical physics (mechanics and electrodynamics). And they show that the processes of electrons in atoms (molecules) are subject to the laws of classical physics.** ***A categorical claim follows from this fact: that the emission and absorption of photons by atoms (molecules) are classical phenomena.***

Emphasis II. It is another question that when electrons in atoms are more than one, they interact with each other and then there occurs interaction between three bodies (the nucleus and two or more electrons) and this problem presently has no solution in physics. That is why N. Bohr's model cannot solve problems about an atom with two or more electrons.

1.5.2. Emission of photons by atoms

An electron in the orbital of an atom with radius r_{i} and velocity $v_{\text{i}} << c$ has magnetic energy W_{Hi}, to which, formally, corresponds frequency ν:

$$\text{a) } W_{\text{Hi}} = \frac{m_{\text{e0}}.v^2}{2}\,; \text{ b) } \nu_{\text{i}} = \frac{W_{\text{Hi}}}{\text{h}}\,; \qquad (1.5\text{-}23)$$

where: h - Planck's constant

Here the electron is in the central electric field $E_{\text{я}}$ of the nucleus, due to which upon it acts a central electric force

$$\text{a) } \vec{F}_{\text{csi}} = q_{\text{e}}.\vec{E}_{\text{я}} = q_{\text{e}}.\frac{Q_{\text{я}}.\vec{r}_0}{4\pi\varepsilon_0 r_1^2} = m_{\text{e0}}.\vec{a}_{\text{esi}}\,; \text{ b) } \vec{a}_{\text{csi}} = \frac{v_{\text{i}}^2}{\text{r}_{\text{i}}}\vec{r}_0\,; \qquad (1.5\text{-}24)$$

where: $Q_{\text{я}}$ is the charge of the nucleus. With hydrogen atom $Q_{\text{e1}} = -q_e$

By analogy to (1.4-9) $\vec{F}_{\text{csi}}$, along pathway $d\vec{r}_{\text{i}}$, must take away electromagnetic energy dW_{ei} from its magnetic W_{Hi} energy (called kinetic energy)

$$dW_{\text{ei}} = \vec{F}_{\text{csi}}.d\vec{r}_{\text{i}} = \frac{q_{\text{e}}^2}{4\pi\varepsilon_0 r_1^2}\left|\vec{r}_0\right|\left|d\vec{r}_{\text{i}}\right|\cos\alpha_{\text{s}} < 0\,;\ d\vec{r}_{\text{l}} = \vec{v}.dt\,; \qquad (1.5\text{-}25)$$

If the projection of the acceleration $\vec{a}_{\text{csi}}$ upon the direction of velocity $\vec{v}_{\text{i}}$, is different from zero, i. e. $\vec{a}_{\text{csi}}$ has an active component on the axis of $\vec{v}_{\text{i}}$. On condition (1.5-3), as a result of the decreased magnetic energy, the electron will move to a

lower orbital, of a smaller radius $r_j < r_i$, and the energy released in $|q_я| = |-q_e|$ (hydrogen atom) is:

$$W_{eij} = W_{fij} = \int_{r_i}^{r_j} dW_{ei} = \frac{q_e^2}{4\pi\varepsilon_0}\left(\frac{1}{r_j} - \frac{1}{r_i}\right) = h.\nu_{ij}\ ; \qquad (1.5\text{-}26)$$

Therefore, the magnetic energy of the electron W_{Hj} and its velocity v_j on the orbital ofradius r_j are:

$$\text{a)}\ W_{Hj} = W_{Hi} - h\nu_{ij} = \frac{m_{e0}.v_i}{2}\ ;\ \text{b)}\ v_i = v_i^2 - \frac{2.h.\nu_{ij}}{m_{e0}}v_i^2\ ; \qquad (1.5\text{-}27)$$

From (1.5-4) after replacement:

$$\text{a)}\ r_i = r_0.n_i^2\ ;\ \text{b)}\ r_j = r_0.n_j^2\ ;\ \text{c)}\ n_i = 1,2...\ ; \qquad (1.5\text{-}28)$$

while allowing for the experimental law of the frequency of the photon through Rydberg constant – R, the result from (1.5-26) is

$$\text{a)}\ \nu = \frac{R}{r_0}\left(\frac{1}{n_j^2} - \frac{1}{n_i^2}\right);\ \text{b)}\ \frac{\nu}{R} = \frac{1}{r_0}\left(\frac{1}{n_j^2} - \frac{1}{n_j^2}\right); \qquad (1.5\text{-}29)$$

the formula (1.5-26) is written in the form:

$$W_{eij} = W_{eij} = \frac{q_e^2}{4.\pi.\varepsilon_0.r_0}\left(\frac{1}{n_j^2} - \frac{1}{n_i^2}\right) = h.\nu_{ij}\ ; \qquad (1.5\text{-}30)$$

And Planck's constant has this value:

$$h = q_e^2\left(4\pi\varepsilon_0.r_0.R\right)^{-1} = const\ ; \qquad (.1.5\text{-}31)$$

The energy of the photon at the velocities v_i and v_j.

$$W_{fij} = W_{Hi} - W_{Hj} = \frac{m_{e0}}{2}.\left(v_i - v_j\right); \qquad (1.5\text{-}32)$$

1.6. Absorption of photons by atoms

When a photon with energy $W_{f0} = h.\nu_0$ hits an electron in an atom with orbital of radius r_i, velocity $\vec{v}_i$; and magnetic energy $W_{нei} = \frac{m_{e0}.v_i^2}{2}$, and is absorbed by the atom, the magnetic energy of the electron increases to

$$W_{нej} = W_{нei} + W_{R0} = \frac{m_{e0}.v_j^2}{2}\ ; \qquad (1.6\text{-}1)$$

And the velocity and its centrifugal acceleration become

$$\text{a)}\ v_i = v_i + \frac{2.W_{R0}}{m_{e0}}\ ;\ \text{b)}\ a_{ckj} = v_i / r_j > a_{ci} = v_i / r_i\ ; \qquad (1.6\text{-}2)$$

Because of this centrifugal force F_{ekj} increases in relation to the attractive force at the orbital with $r_j - \left|\vec{F}_{ckj}\right| > \left|\vec{F}_{cei}\right|$ and the electron moves at distance Δr_{ij} into a

higher orbital with radius $r_j > r_i$, i. e.

$$r_j = r_i + \Delta r_{ij} \approx r_i + \frac{W_{R0}}{F_{ekj}} \approx r_i + \frac{W_{R0}}{m_{e0}.a_{ckj}}; \quad (1.6\text{-}3)$$

1.7. Wave energies for a certain interval of time

1.7.1. Introduction

In classical mechanics, wave energies *W* are described for moment values of time *t*, i. e.

$$W = W_0.\sin^2 \omega_0 t = w(t); \quad (1.7\text{-}1)$$

The energy emitted by the atom (photon) is described as end time equal to the time of emission $\Delta t = \tau$, with the formula

$$W_f = h.\nu_0 \quad (1.7\text{-}2)$$

Where: W_0 is the amplitude of the emitted energy; $\omega_0 = 2\pi.\nu_0$ - the angular frequency; *h* - Planck's constant. To make analyses of the features of (1.7-1) and (1.7-2), they should be reduced under the same condition, i. e. (1.7-1) has to be written again for end time $\Delta t = n.T_0$ (*n* is integer, T_0 - period of one wave).

1.7.2. Wave energies for end time $\Delta t = n.T_0$ under various conditions

1.7.2.1. With oscillatory motion of mass m_0

a) $r = r_0 \sin \omega_0 t$; b) $dr = v_r.dt = r_0.\omega_0.\cos \omega_0 t.dt$; (1.7-3)

the velocity v_r and the acceleration a_r of the mass m_0 are:

a) $v_r = r_0.\omega_0.\cos \omega_0 t$; b) $a_r = -r_0.\omega_0^2.\sin \omega_0 t = -a_0.\sin \omega_0 t$; (1.7-4)

The force, which generates the movement of the mass m_0 according to (1.7-3)a, is:

a) $F = m_0.a_2 = -m_v.r_0.\omega_0^2.\sin \omega_0 t = -F_0.\sin \omega_0 t$; b) $F_0 = m_0.r_0.\omega_0^2$; (1.7-5)

The energy of *n* waves for time $\tau_n = n.T_0$ or along pathway $r_n = n.\lambda_0 = n.\frac{v_0}{\nu_0}$ (where $v_0 = \nu_0.\lambda_0$ is the wave velocity) is:

$$W_n = \int_0^{r_n} F.dr = 2.F_0.a_0 \int_0^{\frac{\tau_n}{4}} \sin 2.\omega_0.dt = \frac{m_0.4\pi^2.r_0^2.n.\nu_0}{2} = H_n.\nu_0; \quad (1.7\text{-}6)$$

$$H_n = \frac{m_0.4\pi^2.r_0^2.n}{2} = const; \quad (1.7\text{-}7)$$

for a concrete case at assumed constant values of: m_0, r_0 and *n*.

1.7.2.2. With waves in elacstic environment

When force $F = F_0.\sin \omega_0 t$ is applied to the tip of a rod with modular elasticity

(by Jung) E_0, density of the mass ρ and cross-section $S = 1m^2$, it generates deformation ε and compactness ρ_ε, as follows:

a) $\varepsilon = \dfrac{F}{S.E_0} = \varepsilon_0.\sin\omega_0 t$; b) $\rho_\varepsilon = \rho_{\varepsilon 0}.\sin\omega_0 t$; c) $\varepsilon_0 = \dfrac{F_0}{\mathrm{S.E}_0}$;

d) $\rho_{\varepsilon 0} = \varepsilon_0.\rho_0$; (1.7-8)

The compactness spreads at wave velocity

$$v_0 = \left(\frac{E_0}{\rho_0}\right)^{\frac{1}{2}} = \nu_0.\lambda_0 = \frac{w_0}{\rho_0} \; ; \qquad (1.7\text{-}9)$$

A along the amplitude r_0 according to the law

a) $r = r_0.\sin\omega_0 t$; b) $dr = r_0.\omega_0.\cos\omega\, t.dt$;

If the same approach is used as in the preceding item 1.7.2.1. to the energy of *n* waves or pathway $r_\mathrm{n} = n.\lambda$ or time $\tau_\mathrm{n} = n.T_0$ we obtain the sum of the energies *W* of *n* waves equal to

a) $W = \rho_0.\varepsilon_0.r_0^2.2\pi^2.\nu_0 = h_\mathrm{n}.\nu_0$; b) $W_\mathrm{n} = w_\mathrm{B}.V = H_\mathrm{n}.\nu_0$; (1.7-10)

where:

a) $h_\mathrm{n} = \rho_0.\varepsilon_0.r_0^2.2\pi^2$; b) $H_\mathrm{n} = h_\mathrm{n}.V = \rho_0.\varepsilon_0.r_0^2.2\pi^2.\nu = const$; (1.7-11)

as the constant H_n is concrete for the concrete conditions and volume *V* of the wave process.

1.7.2.3. With ordinary electromagnetic waves

For convenience, the solution here is for flat waves, but the results are universal and hold true for non-flat wave, too.

The electric field of the waves is:

a) $E = E_0.\sin\omega_0.t$; b) $\omega_0 = 2\pi\nu_0$; (1.7-12)

Since the quantities E_0 and ν_0 are closely connected into one whole, they can be described as interrelated in the form:

a) $K_\mathrm{E} = \dfrac{E_0}{\nu_0}$; b) $E_0 = K_\mathrm{E}.\nu_0$; c) $K_\mathrm{E} \rightarrow$ dimensionality $\left[L.M.T^{-2}I^{-1}\right]$;(1.7-13)

The density of the energy of one flat wave is:

a) $w = \varepsilon_0.E_0^2.\sin\omega_0 t = \varepsilon_0 K_\mathrm{E}^2.\nu_0^2.\sin^2\omega_0 t = w_0.\sin^2\omega_0 t$;

b) $w_0 = \varepsilon_0.K_\mathrm{E}^2.\nu_0^2$; (1.7-14)

The sum of the densities of the energies *w* of *n* waves is integrated for time $\tau_\mathrm{n} = n.T_0$ and we obtain:

a) $W = w_0.\tau_\mathrm{n} = \dfrac{\varepsilon_0.K_\mathrm{E}^2.n.\nu_0}{2} = h_\mathrm{n}.\nu_0$; b) $W_\mathrm{n} = w_\mathrm{n}.V = H_\mathrm{n}.\nu_0$; (1.7-15)

where:

a) $h_{\mathrm{n}} = \dfrac{\varepsilon_0 . K_{\mathrm{E}}^2 . n}{2} = const$; b) $H_{\mathrm{n}} = h_{\mathrm{n}} . V = const. \times volume;$ (1.7-16)

where: h_{n} and H_{n} are constants for the concrete case of (1.7-12) and at constant volume V.

1.7.2.4. With emission from an atom according to Bohr's planetary model

Here the concrete case is the firm condition in Bohr's model of hydrogen atom. In this model, an electron of charge q_{e} moves in a field of nucleus $E_{\mathrm{я}}$, whose charge has equal value but opposite charge compared to the electron. The moment values, according to classical electrodynamics, of the force F_{e}, which acts upon the electron and upon its energy W_{e} at distance r of the electrons from the nucleus, and after we assume $r = n^2 . r_0$ (n = integer 1, 2, 3, …, r_0 is the minimal radius) we derive the formulae:

a) $F_{\mathrm{e}} = q_{\mathrm{e}} . E_{\mathrm{я}} = \dfrac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0 r^2}$; b) $W_{\mathrm{e}} = \int F . dr = \dfrac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0 r} = \dfrac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0 r_0 n^2}$; (1.7-17)

During the transition from an orbital of radius r_{n1} to an orbital - r_{n2}, because the electron moves at acceleration, it emits energy (photon) equal to

$$W_{\mathrm{e}} = W_{\mathrm{en1}} - W_{\mathrm{en2}} = \frac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0}\left(\frac{1}{r_{\mathrm{n1}}} - \frac{1}{r_{\mathrm{n2}}}\right) = \frac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0 r_0}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = h.\nu \qquad (1.7\text{-}18)$$

Since N. Bohr, in "The Spectra of Hydrogen and Helium Nature. 1915,95,6,7" referring to hydrogen, gives the summarized experiment on the frequency with Planck's formula, the frequency, therefore, is

a) $\nu = K\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$; $b = \left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right) = \left(n_1^{-2} - n_2^{-2}\right) = \dfrac{\nu}{K}$; (1.7-19)

After we replace, in the solution (17-18) of electrodynamics, the summarized experiment of 1890-1900 (1.7-19)a cited by Bohr, we derive Planck's formula:

$W_{\mathrm{e}} = h.\nu$; (1.7-20)

where: $h = \dfrac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0 . r_0 . K} = const.$ is Planck's constant. (1.7-21)

For solutions with more than one electron, for instance for n electrons, electrodynamics demands that the energies from the interaction of one electron with other (n-1) electrons should also be taken into account. This problem, however, has no solution for the time being. In general, the problem of interaction between three bodies has no complete solution in physics. That is why there is no solution to Bohr's model for more than one electron, either.

In this regard, Bohr's model is adequate to reality, but it has a solution for only one electron.

1.7.2.5. Emission by atoms of substance at deformation

The electromagnetic forces of cohesion between atoms (molecules) of substance

are given as derivatives of Lenard-Jones potential. In a significantly simplified model of the forces of cohesion as forces between the electron in an atom and the nucleus of the atom, as in case 1.7.2.4. where in normal condition of r and r_0, and at deformation ε (see ε in case 1.7.2.2.) the distance $r_\varepsilon = r_0(1 \pm \varepsilon)$. At these distances, force F_ε and the energy W_ε are

$$\text{a) } F_\varepsilon = \frac{q_e^2}{4\pi\varepsilon_0 r_0^2 (1 \pm \varepsilon)^2}\text{; b) } W_\varepsilon = \frac{q_e^2}{4\pi\varepsilon_0 r_0 (1 \pm \varepsilon)}; \tag{1.7-22}$$

In the process of deformation the atom emits energy

$$W_{\varepsilon f} = W_0 - W_\varepsilon = \frac{q_e^2 \chi}{4\pi\varepsilon_0 r_0 (1 \pm \varepsilon)^2} \approx \frac{q_e^2 (1 \pm \varepsilon).\varepsilon}{4\pi\varepsilon_0 r_0} \tag{1.7-23}$$

Because at $\varepsilon << 1 \rightarrow (1-\varepsilon)^{-1} \approx (1+\varepsilon)$; $(1+\varepsilon)^{-1} \approx (1-\varepsilon)$;

The thermal energy released in the form of photons is proportional to $W_{\varepsilon f}$ (1.7-23) inside and outside the substance and it heats the substance, as it is in thermal emission according to Max Planck.

Energy losses and heating of rubbing surfaces should be treated similarly. Because the surfaces have roughnesses of the order of the size of a few molecules, then at friction, part of these roughnesses get deformed or cut off. For a process ofa qualitative model like this one, it is possible to explain qualitatively energy losses or heat released during friction.

Emphasis. Every mechanical force interaction on a substance (push, pull, bending, twisting, and liquids moving – stirring or flowing) results in deformation of the orbitals of electrons in its atoms (molecules).

Due to these mechanical processes inside or on the surface of a substance, inside or outside of it, photons (electromagnetic waves) are emitted. Their quantity (the density) depends on:

- size of deformations of the orbitals;
- number of deformed atoms (molecules);
- kind of substance: a solid body or liquid;
- temperature of the substance.

1.7.2.6. Oscillating current frame of capacity c_0 and inductivity L_0

The wave equation of an oscillating current frame of capacity $c_0 \pm 0$, inductivity $L_0 \neq 0$ and resistance $R = 0$ is

$$\frac{d^2Q}{dt^2} + \frac{1}{L_0.c_0}.Q = \frac{d^2Q}{dt^2} + \omega_0^2.Q = 0; \tag{1.7-24}$$

Where: electric charge Q of c_0 and the angular frequency ω_0 are

$$\text{a) } Q = Q_0.\sin(\omega_0.t + y_0)\text{; b) } \omega_0 = \frac{1}{L_0.c_0} = 4\pi^2\nu_0^2;$$

$$\text{c) } \nu_0^2 = (4\pi^2 L_0.c_0)^{-1}; \tag{1.7-25}$$

The current i and the voltage are

a) $i = \frac{dQ}{dt} = io.\omega \frac{L_0.i_0^2}{2}$; b) $i_0 = Q_0.\omega_0$; c) $U = -L_0.\frac{di}{\mathrm{dt}} = \frac{Q}{c_0}$; (1.7-26)

The full energy of the frame is $W_0 = W_\mathrm{E} = W_\mathrm{L}$, i. e.

$$W_0 = \frac{Q_0^2}{2.\mathrm{c}_0} = \frac{L_0 i_0^2}{2} = \frac{L_0.\omega_0^2.Q_0^2}{2} ; \quad (1.7\text{-}27)$$

On condition that the length of frame l_0 is much shorter than the length of wave λ_0 , i. e.

$$l_0 << \lambda_0 = \frac{c}{\nu_0} ; \quad (1.7\text{-}28)$$

The energy of one wave of length λ_0 is

a) $W_\lambda = W_0.\lambda_0.2.L_0.\pi^2.Q_0^2.\nu_0 = H_\lambda.\nu_0$; b) $H_\lambda = 2.L_0.\pi^2.Q_0.c = const.$;(1.8-6)

where: c is the velocity of electromagnetic energy in the frame l_0 .

For time $\tau = n.T_0$ or distance $r = n.\lambda_0$ the wave energy

a) $W_\mathrm{n} = n.W_\lambda = H_\mathrm{n}.\nu_0$; b) $H_\mathrm{n} = n.H_\lambda$; (1.7-29)

1.7.2.7. Peculiarities of the de Broglie's waves

This presentation of de Broglie's hypothesis is according to Wichmann's book)[1], chapter V. According to this hypothesis, every body of mass m_0 at rest ($v = 0$), is a wave package with group velocity v, where v is the velocity of motion of the body, having momentum P, mass m and length of wave λ_B of de Broglie, as follows:

a) $P = m.v$; b) $m = m_0.\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}$; c) $\lambda_\mathrm{B} = \frac{h}{p} = \frac{h}{m.v}$; (1.7-30)

where: h is Planck's constant

From λ_B and the velocity v we determine frequency ν_B of de Broglie's waves and the energy of W_B , as follows

a) $\nu_\mathrm{B} = \frac{v}{\lambda_\mathrm{B}} = \frac{m.v^2}{h}$; b) $W_\mathrm{B} = h.\nu_\mathrm{B} = m.v^2$ (1.7-31)

The real value of the energy W_R of a body with mass m_0 at velocity v, according to modern physics is:

$$W_\mathrm{R} = m.c^2 = m_0.c^2\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} \quad (1.7\text{-}32)$$

---

[1] E. H. Wichmann. Berkeley Physics course, Quantum Physics, volume IV. Mc. Graw, Hill Rook company. 1967.

It is evident that the relation of W_B and W_R is:

a) $k_B = \frac{W_B}{W_R} = \frac{m.v^2}{m.c^2} = \frac{v^2}{c^2} << 1$; b) $W_B << W_R$; (1.7-33)

Id est the energy W_R of de Broglie's waves of the body is incompatible with the law energy conservation, because their energy is much less than the actual energy of the body W_R. Or **the law for energy conservation rejects any possibility for de Broglie's possibility to actually exist, i. e. de Broglie's hypothesis is unreal.**

If the energy of de Broglie's waves is computed for one electron of the orbital of an atom, which has mass $m_{e0} = 9.1.10^{-31}$ kg and velocity of the order of 10^6m/s

$W_{BE} = m_{e0}.v_e = 9{,}1.10^{-31}.10^{12} = 9{,}1.10^{-19} J$; (1.7-34)

Its relation to its real energy W_{Re} is

a) $k_B = \frac{W_{Be}}{W_{Re}} = \frac{m_{e0}.v_e^2}{m_{e0}.c^2} = \frac{v_e}{c^2} = \frac{10^{12}}{9.10^{18}} = 1{,}1.10^{-5} W_{Re}$;

b) $W_{BE} = 1{,}1.10^{-5} W_{RE}$; (1.7-35)

When an electron e_0^- and a positron e_0^+ annihilate, two photons γ are generated, the energy of the photon λ being $W_\gamma = h.\nu$, i. e.

a) $e_0^- + e_0^+ \rightarrow 2$; b); b) $W_{f\gamma} = h.\nu = m_{e0}.c^2 = 8{,}19.10^{-14} J$; (1.7-36)

Here the frequency of the photon ν and its relevant length λ coincide with these in Compton's effect.

a) $\lambda = \lambda_k = 2{,}42.10^{-12} m$;

b) $\nu = \nu_k = \frac{c}{\lambda_k} = \frac{3.10^8}{2.42.10^{-12}} = 1{,}23.10^{20} Hz$ (1.7-38)

The energy of de Broglie's waves of the electron $W_{Be} = 9{,}1.10^{-19} J$ (1.7-34) and the energy emitted as a photon $W_{f\gamma} = 8{,}19.10^{-14} J$ (1.7-36) confirm the unreality of de Broglie's waves, since it is impossible for an electron with energy of de Broglie's waves $9{,}1.10^{-19} J$ to emit a hundred thousand times larger energy ($W_{f\gamma} = 8{,}19.10^{-14} J$).

This obvious fact calls in question the quantum mechanics, too, which treats the energy of electrons in the atom as energy of de Broglie's waves.

1.7.2.8. Comment on the cases from 1.7.2.1 to 1.7.2.7

The above theoretical inferences are experimentally validated. These facts, as a summary, should be interpreted as a logical physical principle, which reads:

The energies of all wave and oscillatory processes for a determined, finite interval of time are equal to the product of one constant by the frequency of the process.

This principle is a universal model, regardless of the consequences, which it imposes on the development of physics. And this universal principle rejects the

claims in the book "Quantum Physics - Berkeley Physics" volume IV. by Eyvind H. Wichmann. Mc. Graw-Hill. Book company, 1967, where in chapter 1, paragraph 46 is written: *"It will further become clear that the formula $W = h.\nu$ expresses the fundamental principle of quantum physics, namely, the universal character of this relation between the energy W and the frequency ν. This dependency is absolutely alien to classical physics. And the mysterious constant h is a manifestation of the secrets of nature still to be revealed."*

With these facts it is evident that scientists dealing with the quantum mechanics (physics), because of the euphoria, which has overwhelmed them, and without making a profound enough theoretical and experimental analysis, have created one of the myths of quantum mechanics, that the equation of wave energy for a certain interval of time $\Delta t = \tau = m.T_0$ in the form of (1.7-6) holds true only for the photons emitted by the atoms. *The evidence presented in the preceding paragraphs unconditionally and most categorically disproves incorrect ideas and frees the fundaments of physics from this incorrect idea which has turned into a myth and returns to classical physics a right which was taken away from it.*

1.8. The angular momentum in electrodynamics is not constant

The angular momentum of the electron in transition from one orbital *n*, which is L_n with radius r_n to another L_k with radius r_k for time Δt is:

$$\vec{L} = \vec{r}.\vec{M}.\Delta t = \frac{\vec{r}q_e^2\Delta t\vec{r}_0}{4\pi\varepsilon_0 r^2} = \frac{q_e^2\Delta t\vec{r}_0}{4\pi\varepsilon_0 r} = f\left(t.r^{-1}\right) \neq const\,; \qquad (1.8\text{-}1)$$

The relation of L_n to L_k is

$$\frac{L_n}{L_k} = \frac{r_k}{r_n} \neq 1\,; \qquad (1.8\text{-}2)$$

For this Bohr postulated the quantum alternating angular momentum

a) L = n . h; b) n = 1; 2; 3… - integers (1.8-3)

Because in mechanics the bodies which are neutral with regard to electric charge do not emit energy W_L, and the angular momentum L is a result of the law for conservation of kinetic energy W_{ko}, for time τ, and, on the other hand, the distance $r = v.t$, then at $t = \tau.v$.

$$\text{a)}\ L_M = m.v.r = \frac{m.v^2}{2}.2.\tau = W_k.2\tau = const\,;\ \text{b)}\ W_k = \frac{L_M}{2\tau}\,;\ W_k = const\,; (1.8\text{-}4)$$

In electrodynamics, bodies can emit energy W_L, and as a result of W_L their initial kinetic energy W_{k0} decreases by $W_L(t)$, which is function of the acceleration and the time. Because of this, the angular momentum in electrodynamics is

$$L_e = \left(W_{ko} - W_L(t)\right).2\tau \neq const\,; \qquad (1.8\text{-}5)$$

1.9. Velocities of wave processes and Doppler Effect-DE

Let ψ denotes the value of wave quantity of a wave process (mechanical or electromagnetic), which is described as a sinusoid process:

$$\psi = A_0.\sin(w_0 t - k.r); \quad (1.9\text{-}1)$$

where: A_0 is the amplitude of the sinusoid wave; $\omega_0 = r.\pi.\nu$ - the angular frequency at ν - the frequency of the process; t - the time, r - the distance; $k = \frac{\omega_0}{v_0}$ - a wave number; v_0 - wave velocity.

The second derivatives of ψ with regard of time and distance, after a relevant processing, are:

$$\frac{d^2\psi}{dt^2} = -\frac{\omega_0.A_0}{2}.\sin r(\omega_0 t - kr); \quad (1.9\text{-}2)$$

$$\frac{d^2\psi}{d^2} = -\frac{k^2.A_0}{2}.\sin r(\omega_0 t - kr); \quad (1.9\text{-}3)$$

The wave equation of wave processes is

$$\frac{d^2\psi}{dt^2} = v^2.\frac{d^2\psi}{dr^2}; \quad (.1.9\text{-}4)$$

from where we derive the wave velocity v of wave spread, for mechanical deformations v_0, and for the field electromagnetic ones - c, as follows:

a)

$$v^2 = v_0^2 = c^2 = \frac{d^2\psi}{dt^2} \Big/ \frac{d^2\psi}{dr} = \frac{w_0.A_0^2}{k^2.A_0} = \frac{w}{\rho} = \frac{density\,of\,energy}{density\,of\,mass} =$$

$$= \frac{energy}{mass};\ \text{b)}\ \frac{Joule}{kg} \to \left[J.kg^{-1}\right];\ \text{c)}\ v_0^2 = c^2 = \frac{W}{m};\ \text{d)}\ W = m.c^2; \quad (1.9\text{-}5)$$

where the dependence (1.9-5) *d*, notated in the form $w = \rho.c^2$ was given by Maxwell in "Treatise on electricity and magnetism" - 1879, paragraph 792. For electromagnetic waves (light).

This solution is in accordance with classical physics and is also in force for mechanical and electromagnetic waves, where the square of the velocity

$$v_0^2 = \frac{w}{\rho} = (\nu.\lambda)^2;\ (\lambda \text{ is the length of the wave - } \lambda = \frac{v_0}{\nu}) \quad (1.9\text{-}6)$$

An example of mechanical deformational waves

$$v_0^2 = \frac{E_0}{\rho};\ (E_0 \text{ is the module of elasticity of Jung}) \quad (1.9\text{-}7)$$

a) $E_0 = \frac{F}{S} = \frac{force}{area}$; b) $E_0 = \frac{F}{S} \rightarrow$

$$\frac{\left[J.m^{-1}\right]}{\left[m^2\right]} = \left[\frac{J}{m^3}\right] = density\ of\ energy = w_n ; \qquad (1.9\text{-}8)$$

because in dimensionality, the module E_0 is density of energy. I. e. the wave velocity of sound is according to (1.9-5)a

$$v_{sound} = \left(\frac{w}{\rho}\right)^{1/2} ; \qquad (1.9\text{-}9)$$

It is of importance here to point out, that from physical viewpoint, both as a conclusion and in essence, there is no qualitative difference, as physical notions between the velocities v_0 and c (of substance and of field), but there is only quantitative difference in their numerical values, as a result of the difference in the numerical values of w_B and w_c and, respectively, between ρ_0 and ρ_c, due to which in practice always

$$v_B = v_0 << v_{EM} = c . \qquad (1.9\text{-}10)$$

Here both for v_0 and for c, the well-known and experimentally validated effect holds true – Doppler effect - 1842-1867, out of which follow the inferences:

A. (**First**). The velocities v_0 and c do not depend on the velocities $\pm v_g$ of the generators (sources). And indeed, if the direction of the wave velocities v_0 and c and of the generator $\pm v_g$, are parallel, at generator's frequency ν_g and length λ_g of the wave, which have wave velocities v_0 and c we have

$$a)\ \nu_g = \frac{v_0}{\lambda_g} = \frac{c}{\lambda_g} ;\ b)\ \lambda_g = \frac{v_0}{\nu_g} = \frac{c}{\nu_g} ; \qquad (1.9\text{-}11)$$

As a result of the Doppler effect (**DE)**, at the velocity of the generator $\pm v_g$, ν_B and λ_B change as follows:

$$a)\ \nu_B = \nu_0 = \nu_{gB}.\frac{v_0 \pm v_H}{v_0} = \nu_{gB}.\frac{u_0}{v_0} ;\ b)\ \lambda_B = \lambda_0 = \lambda_{gB}.\frac{v_0}{v_0 \pm v_H} = \lambda_{gB}.\frac{v_0}{u_0} ; \qquad (1.9\text{-}12)$$

and

$$a)\ \nu_{EM} = \nu_C = \nu_{gB}.\frac{c \pm v_H}{c} = \nu_{gC}\frac{u_c}{c} \neq c ;$$

$$b)\ \lambda_{EM} = \lambda_c = \lambda_{gC}.\frac{c}{c \pm v_H} = \lambda_{gC}.\frac{c}{u_c} \neq \lambda_g ; \qquad (1.9\text{-}13)$$

where:

$$a)\ u_0 = \nu_B.\lambda_B = v_0 \pm v_H ;\ b)\ u_c = c \pm v_H ; \qquad (1.9\text{-}14)$$

proceeding from (1.9-6), the velocities u_0 and u_c of the wave processes relative to the generator (source) are respectively:

$$a)\ u_0 = \nu_B.\lambda_B = \nu_0.\lambda_0 = const ;\ b)\ u_C = \nu_C.\lambda_C = c = const . \qquad (1.9\text{-}15)$$

Id est u_0 and u_c do not depend on the velocities $\pm v_g$ of the generators (sources).

B. (**Second**) The velocities of the wave processes u_0 and u_c relative to the observers (receivers) depend on the velocities $\pm v_H \neq 0$ of the observers (receivers).

The frequencies $v_B = v_0$ and $v_{EM} = v_C$ of the relevant material and field wave processes relative to those of the observers (receivers) moving at velocity $\pm v_H$ according to **DE** in classical physics are

a) $v_B = v_0 = v_{g0} \cdot \frac{v_0 \pm v_H}{v_0} = v_{gB} \cdot \frac{u_{HB}}{v_0} \neq v_{g0} \neq const.$;

b) $v_{EM} = v_C = v_{gc} \cdot \frac{c \pm v_H}{c} = v_{gC} \frac{u_{Hc}}{c} \neq c \neq const.$; (1.9-16)

Here v_0 and v_c have also meaning as the number of the lengths of the waves λ_0 and λ_c, which the observer (receiver) receives (accepts) for a unit of time ($T_0 = \frac{1}{v_0}$; $T_C = \frac{1}{v_C}$). The lengths of the waves λ_0 and λ_c, relative to the observer in this case, as a classical case, need not be changed, because they remain only unchangeable relative to the observer. And since the velocities of wave processes are given in (1.9-15)

a) $u_0 = v_0 . \lambda_0 = v_{gB} \cdot \frac{v_0 \pm v_H}{v_0} . \lambda_{gB} = v_0 \pm v_H \neq C^{te}$;

b) $u_C = v_C , \frac{c \pm V_H}{c} . \lambda_{gC} = c \pm v_H \neq C^{te}$; (1.9-17)

because

a) $v_{gB} . \lambda_{gB} = v_0$; b) $v_{gC} . \lambda_{gC} = c$. (1.9-18)

Therefore, from the first (A) and second (B) cases follow the inferences:

A) *the velocities of wave processes relative to the generator are constant (1.9-15) and do not depend on its velocity of motion.*

B) *The velocities of wave processes relative to the observer are not constant (1.9-17), when the observer is in motion.* This conclusion is known in practice; a number of machines are constructed and used based on it.

Moreover, conclusion B) was also confirmed by Einstein in [1][*] (paragraph 7) where at angle $\varphi = 0$ for the frequency was given the expression:

$$v_C = v_{gC} \cdot \frac{c - v_H}{c \left(1 - \frac{v_H^2}{c^2} \right)^{\frac{1}{2}}} . \quad (1.9\text{-}19)$$

And since for the length λ_{0C}, the distance λ_C, according to [1] (paragraph 7) for

[*] [1]A. Einstein Zur Elektrodynamic der bewegter Körper Ann.d.Rhis. 1905.17.821-921.

Inertial Reference system (**IRS**) at velocity v_H, shortens to:

$$\lambda_C = \lambda_{gC}.\left(1-\frac{v_H^2}{c^2}\right)^{\frac{1}{2}}; \qquad (1.9\text{-}20)$$

then, according to (1.9-20), the velocity of light relative to the observer is:

$$u_{CH} = u_C = \nu_C.\lambda_C = \frac{\nu_{gC}.\lambda_{gC}}{c}.(c-v_H) \neq const\ ;\ \nu_{gC}.\lambda_{gC} = c\ . \qquad (1.9\text{-}21)$$

In the special theory of relativity - **STR**, too, in [1] (paragraph 4), Einstein proved, that the velocity of light relative to the observer is not constant and is equal to the velocity of light relative to the observer, derived by the formulae for **DE** of classical physics. In [1] (paragraph 7) respectively (1.9-20), Einstein did not consider the **principle of constancy of the velocity of light (PCSL)**, because in the expression of the frequency should participate the term:

a) $\vec{u}_c = \vec{c} + \vec{v} = c$; and not b) $\vec{u}_c = \vec{c} + \vec{v} \neq c$; (1.9-22)

which contradicts the PCSL - according to STR in [1] (paragraph 3).

Id est, in [1] (paragraph 3) Einstein postulated PCSL and deduced Lorentz transformations from it; also, in [1 in paragraph 7, he deduced (1.9-22)b by rejecting] the PCSL postulated by himself in paragraph 3.

1.10. A model of generation of the inert force of the electron as a model of the inert property of bodies

1.10.1. Basic model

From the law for conservation of energy of mass - LCEM, follows that its active manifestation requires that material objects should have the property of immediate counteracting to any change of their matter (mass) and energy. This property is called inertness - inert property.

The inert property of the bodies is most clearly described with an electrical charge q_e moving at a low velocity (but the conclusion is in force for high velocities as well), such as an electron. The reasons for this are that its electromagnetic field can be ignored at its electric field $\vec{E}_e$ and its magnetic field $\vec{H}_e$ for its mass m_{0e} at rest at low velocity $v_e << c$. Then are in force the dependences

a) $\vec{E}_e = \frac{q_e.\vec{r}_0}{4.\pi.\varepsilon_0.r^2}$; b) $\vec{H}_e = \varepsilon_0.\left[\vec{v}_e.\vec{E}_e\right]$;

c) $W_{e0} = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}}$; d) $m_{0e} = \frac{W_{e0}}{c^2}$, (1.10-1)

where: r_{e0} is the computational (classical) radius of the electron.

Let us consider a magnetic flux $d\Phi_r$, which passes through the elementary cross-section dS_r in point M at distance $\vec{r}_M$ in the plane S, which is perpendicular to the velocity $\vec{v}$ at the moment t of the time

$$dS_r = 1.dr\,, \qquad (1.10\text{-}2)$$

where: one (1) is the size of the side of *dS*, in the direction of the velocity $\vec{v}$; *dr* – the size along $\vec{r}_M$.

The magnetic induction in point M is $\vec{B}_M = \mu_0.\vec{H}_{EM}$, and its flux $d\Phi_{rM}$ through dS_r is

$$d\Phi_{rM} = \mu_0.H_{EM}.dr = \frac{\mu_0.q_e.v.dr}{4.\pi.r^2} = \mu_0\frac{q_e.a.t.dr}{4.\pi.r^2};\ v = a.t; \qquad (1.10\text{-}3)$$

The magnetic flux Φ_{rM} for a unit of length in direction of $\vec{v}$ in the plane *S*, within the limits of r_{e0} until infinity is

$$\Phi_{es} = \int_{r_{e0}}^{\infty} d\Phi_{rM} = \frac{q_e.a.t}{4.\pi.\varepsilon_0.c^2.r_{e0}}\,, \text{ with taking into account } \mu_0.\varepsilon_0.c^2 = 1\,; (1.10\text{-}4)$$

The magnetic flux Φ_{es} comprises the center of the electron from r_{e0} to infinity for a unit of length along the acceleration $\vec{a}$ at the moment of time *t*. According to Faraday's law, when this flux changes with time in the center of the electron is induced electromoving field (EMF) $\vec{E}_{ie}$ its direction being opposite to the acceleration:

$$\vec{E}_{ie} = -\frac{d\Phi_{es}}{dt}.\vec{i}_a = \frac{q_e.a.\vec{i}_a}{4.\pi.\varepsilon_0.c^2.r^2} = \frac{m_{e0}}{q_e}.\vec{a}\ ; \rightarrow \vec{i}_a = \frac{\vec{a}}{|\vec{a}|}\ ; \qquad (1.10\text{-}5)$$

The interaction of $\vec{E}_{ie}$ with charge q_e of the electron generates electric force whose value is

$$\vec{F}_{ie} = q_e.\vec{E}_{ie} = -m_{e0}.\vec{a}\ ; \qquad (1.10\text{-}6)$$

which has equal value but opposite sign to the moving force of the electron $\vec{F}_a$ from the external electric field $\vec{E}_B$

$$\text{a) } \vec{F}_a = q_e.\vec{E}_B\ ;\ \text{b) } \vec{F}_a + \vec{F}_{ie} = 0\ ;\ \text{c) } \vec{F}_{ie} = -\vec{F}_a\ ; \qquad (1.10\text{-}7)$$

where: m_{e0} is according to (1.10-1) *d*.

In essence, the inert property is a result from (is grounded in) LCEM. According to the principle for conservation of the tandem of matter-energy, it is *necessary that the material object should have the natural property of being able to counteract to any manifestation, which could result into a change in its tandem (matter- energy)*. And this counteraction has to be with a tandem equal in value but opposite in sign to the one which has been imparted to it or released from it.

1.10.2. Inert force of an external electrically neutral object

Here, first of all, it should be pointed out that an external electrically neutral object means that it has no external primary electric field, but has only an external gravitational field, which is also electric, but a secondary electromagnetic field, i. e. it has an external electric field, but that is only secondary – a gravitational one, which has no vortex component (rot G=0).

Let in a mental experiment there exist an external electrically neutral object, which has a spherical volume V_0, and in its interior, without annihilating, are placed symmetrically and unifomly the same number of n electrons e^- and positrons e^+, the object of e^- and e^+ being with volume V_0 and with covering surface S_0. Since under these conditions, there is no primary electric flux Φ_E outside V_0 or S_0, in force is the dependence

$$\Phi_E = \iiint_{(V_0)} div\vec{E}.dV = \oiint_{(S_0)} \vec{E}.d\vec{S} = 0; \qquad (1.10\text{-}8)$$

this object is electrically neutral, in the sense specified above.

Inside the volume V_0, there are electrons and positrons with their masses (1.10-1)*d* due to which the object has a resultant mass $m_0 \neq 0$, which is a sum of the masses of the electrons and positrons, without their defect masses from the interaction between them.

If, as a whole, this object of *2n* electric charges with mass m_0 is set in motion with acceleration $\vec{a}_0$, the inert force $\vec{F}_{i0}$ of its mass m_0 is

$$\vec{F}_{i0} = -m_0.\vec{a}_0; \qquad (1.10\text{-}9)$$

The real conclusion that follows from this mental experiment is that the external electrically neutral object, which internally contains only electric charges, also manifests its electromagnetic property of inertness. Simultaneously with that the mass m_0, also reveals its gravitational property by generating gravitational field and force.

1.11. Law (formula) of addition of velocities

The following conditions, which are unconditionally related to the notion of velocity of motion, should be taken into consideration.

First. **The velocity of motion of a material object with matter (mass) m_V as a derivative of pathway $\vec{r}$ relative to the time *t* - $\vec{v} = d\vec{r}/dt$, is not an independent object (quantity), but is inseparable from the matter m_V of the object, which moves at velocity $\vec{v}$.** And through the product of $m_V.\vec{v}$ is formed the really existing and independent physical quantity called momentum - $\vec{P} = m_V.\vec{v}$, through which objects interact between themselves.

Second. Only the velocity between two objects, i. e. the relative velocity, which is also the velocity of interaction, can be interpreted.

Third. Because of the above considerations, velocity is not used in quantum mechanics, but momentum $\vec{P}$, which choice is more reasonable from a physical viewpoint, whereas velocity is a more convenient notion from viewpoint of computing.

Fourth. Newton implicitly agreed that $m_{V1} = m_{V2...} = 1$, because of which the velocity $\vec{v}$ ($v << c$) is interpreted as an implicit abstraction of $\vec{P}$, i. e.

a) $\vec{P} = m_V.\vec{v} \rightarrow$ b) $\vec{P} = 1.\vec{v} = \vec{v}$; at $m_V = 1 = const$; (1.11-1)

In this sense, Newton's physics, the addition of $\vec{v}_A$ and $\vec{v}_B$ was reduced to

addition of their momentums at $m_{VA} = m_{VB} = 1$, and the resultant velocity $\vec{v}_{AB}$ is

a) $\vec{P}_{AB} = \vec{P}_A + \vec{P}_B = \vec{v}_{AB} = \vec{v}_A + \vec{v}_B$; or b) $\vec{v}_{AB} = \vec{v}_A + \vec{v}_B$; (1.11-2)

When computing the dependency of the matter (mass) of the objects *A* and *B* in accordance with (1.3-19) of their velocities relative to IRS – K, it is assumed (for the sake of simplicity), that they move along a straight line at velocities $v_A < c$; $v_B < c$ relative to IRS - K, which is between them. Besides, with matters at rest $m_{A0} = m_{B0} = m_0$ relative to IRS - K', their matters relative to IRS - K at $v > 0$ are

a) $m_{AK} = m_0\left(1 - \beta_A^2\right)^{-1/2}$; b) $m_{BK} = \left(1 - \beta_B^2\right)^{-1/2}$; $\beta_A = \frac{v_A}{c}$; $\beta_A = \frac{v_B}{c}$; (1.11-3)

And the values of their matters one relative to the other (A relative to B and vice versa) are:

a) $m_{AB} = m_{AK}\left(1 - \beta_B^2\right)^{-1/2} = m_{BK}\left(1 - \beta_A^2\right)^{-1/2} =$

$= m_0 = \left(1 - \beta_A^2\right)^{-1/2}.\left(1 - \beta_B^2\right)^{-1/2} = m_{BA}$; (1.11-4)

Their corresponding momentums are

a) $P_{AB} = m_{AB}.v_A$; b) $P_{AB} = m_{AB}.v_B = m_{AB}.v_B$; (1.11-5)

At $m_{A0} = m_{B0} = m_0 = 1$ (1.11-6)

the sum of the momentums is

a) $P_{AB} + P_{BA} = \frac{v_A + v_B}{\left(1 - \beta_A^2\right)^{1/2}.\left(1 - \beta_B^2\right)^{1/2}} = \frac{v_{AB}}{\left(1 - \beta_{AB}^2\right)^{1/2}}$; b) $v_{AB} = -v_{BA}$; (1.11-7)

After raising (1.11-7)a to the second power, and solving it relative to v_{AB}, we derive

$$v_{AB} = v_{BA} = \frac{v_A + v_B}{1 + \frac{v_A.v_B}{c^2}} \text{ at b) } v_A < c;\ v_B < c; \quad (1.11\text{-}8)$$

This formula is derived as a sequence of the Principal (P-13) not using any assumptions from the theory of relativity.

And, for a wave process relative to a moving observer, it is the Doppler effect that is in force (1.9-17).

1.12. Accumulating and spending magnetic (kinetic) energy

We start off from the law that the electron *e* is with electric charge q_e at rest, has electromagnetic energy W_{e0} and mass m_{e0}, as follows:

a) $W_{e0} = m_{e0}.c^2 = \frac{q_e^2}{4.\pi.\varepsilon_0.r_{e0}}$; b) $m_{e0} = \frac{W_{e0}}{c^2}$; (1.12-1)

where: r_{e0} is the classical radius of the electron.

If the electron is set in motion by an external electric field $\vec{E}_B$ with force

$$\vec{F}_{\mathrm{e}} = q_{\mathrm{e}}.\vec{E}_{\mathrm{B}} = \frac{d\left(m_{\mathrm{e}}.\vec{v}\right)}{dt} = \frac{dW_{\mathrm{e}}}{\mathrm{dr}}.\vec{r}_0 = m_{\mathrm{e}}.\vec{a}\,; \qquad (1.12\text{-}2)$$

When integrating the work (energy) $dA = \vec{F}.d\vec{r}$, which is done by $r = 0$ to $r = r$

$$W_{\mathrm{e}} = W_{\mathrm{ke}} = \int_0^r \vec{F}_{\mathrm{e}}.d\vec{r} = \int_0^v \vec{F}_{\mathrm{e}}.\vec{v}.dt = m_{\mathrm{e}0}.c^2.\left[\left(1-\beta^2\right)^{\frac{1}{2}} - 1\right];\ \beta = \frac{v}{c}\,; \qquad (1.12\text{-}3)$$

From (1.12-3) at $v << c$ after developing in power series and taking only the first two terms, we derive Newton's formulae

$$\text{a)}\ W_{\mathrm{e}} = W_{\mathrm{ke}} = \frac{m_{\mathrm{e}0}.v^2}{2}\,;\ \text{b)}\ \vec{F}_{\mathrm{e}} = \frac{dW_{\mathrm{e}}}{\mathrm{ar}}.\vec{r}_0.\frac{d\vec{P}_{\mathrm{e}}}{\mathrm{dt}} = m_{\mathrm{e}0}.\frac{d\vec{V}}{dt} = m_{\mathrm{e}0}.\vec{a}\,; \qquad (1.12.4)$$

In this way it is illustrated how, as a result of the velocity v of the electron, derived from the force $\vec{F}_{\mathrm{e}}$ (1.12-2), generated by the interaction of its charge q_e and the external electric field $\vec{E}_{\mathrm{B}}$, electric energy $dW_{\mathrm{e}} = \vec{F}_{\mathrm{e}}.d\vec{r}$ is transferred from the external electric field $\vec{E}_{\mathrm{B}}$ to the electron, but already converted into magnetic energy $dW_{\mathrm{e}} = dW_e$, as a result of Biot-Savart law. *Id est the energy* $\vec{F}_{\mathrm{e}}.d\vec{r} = dW_{\mathrm{e}}$ *of the external field* E_B *is converted and transferred from it to the electron, but in the form of magnetic energy, which has mass.*

From (1.12-3) as integral of $\vec{F}_{\mathrm{e}}.d\vec{r} = dW_{\mathrm{e}}$ *, the mechanic notion of force is connected with the exchanged electromagnetic energy of the electric field* $\vec{E}_{\mathrm{B}}$ *, which accelerates the mass of the electron, and is already treated as also having electromagnetic nature.* Here, it is still seen from (1.12-1), that **the mass of the electron is proportional to the square of the electric charge,** $\left(\pm q_{\mathrm{e}}\right)^2 > 0$ **, by which it is accounted that the mass is always positive.**

From the sign of the force $\vec{F}_{\mathrm{e}}$ relative to $d\vec{r}$ and $\vec{v} \to \left(d\vec{r} = \vec{v}.dt\right)$, we derive the following interpretations:

$$\text{a) at}\ \vec{F} \uparrow\uparrow \vec{v} \to \Delta W_{\mathrm{k}} = \vec{F}.\vec{v} > 0 \to \Delta m_{\mathrm{e}} = \frac{\Delta W_{\mathrm{k}}}{\mathrm{c}^2} > 0\,; \qquad (1.12\text{-}5)$$

the force is motive;

$$\text{b) at}\ \vec{F} \downarrow\uparrow \vec{v} \to \Delta W_{\mathrm{k}} = \vec{F}.\vec{v} < 0 \to \Delta m_{\mathrm{e}} = \frac{\Delta W_{\mathrm{k}}}{\mathrm{c}^2} < 0\,; \qquad (1.12\text{-}6)$$

the force is resistant.

By these dependences (1.12-5) and (1.12-6), accumulation is explained – the increase and expenditure, or decrease of the kinetic energy of bodies.

Because, when the velocities of motion v of material objects are much lower than the velocity of the electromagnetic waves c, i. e. $v_{\mathrm{i}} << c$ (1.2-21) with preciseness sufficient for practice, the mathematical description of the dynamic processes of material objects is simplified, for example (1.3-11) and others, but the processes themselves are electromagnetic and can be described also by (1.12-3), but this is unnecessary complication. Therefore, it is a physically reliable fact that **ALL NATURAL**

PROCESSES ARE ELECTROMAGNETIC, AND IN DYNAMICS, THEY ARE ONLY ELECTRODYNAMIC.

However, the historical development of electrodynamics has necessitated its division into:

- mechanics, at velocities $v_i << c$; and
- electrodynamics, at velocities $v_i \le c$, and at velocity $v_i \approx c$, it is called relativistic dynamics.

It is, however, time to start using only the notion of electrodynamics at $v_I << c$ as well as at $v_i \approx c$, i. e. **TO EMPHASIZE THE SOLE AND ONLY ELECTROMAGNETIC CHARACTER OF ALL NATURAL PROCESSES. It should be pointed out here, that mechanics is a simplified (rough) description of electrodynamic processes, i. e. MECHANICS IS SPECIFIC ELECTRODYNAMICS.**

1.13. Phenomena in interaction between an electron and positron

1.13.1. At velocities $v_e \approx 0$

From the interaction between electron e_0^- and positron e_0^+ at velocities $v_e \approx 0$ (also called annihilation) we obtain two photons - γ, with respective energies

$$\text{a) } e_0^- + e_0^+ \to 2.\gamma \text{ ; b) } 2.m_{e0}.c^2 = 2.h.\nu_0 = 2.h.\frac{c}{\lambda_0}; \qquad (1.13\text{-}1)$$

hence the frequency ν_0 and the length of the wave λ_0 of the photons are

$$\text{a) } \nu_0 = \frac{m_{e0}.c^2}{h};$$

$$\text{b) } \lambda_0 = \frac{c}{\nu_0} = \frac{h.c}{m_{e0}.c^2} \approx \frac{h}{m_{e0}c} \approx \frac{Planck's\,const.}{internal\,energy\,of\,electron}; \qquad (1.13\text{-}2)$$

Here the expression $m_{e0}.c$ has a dimensionality of an electron momentum, but from a physical viewpoint it cannot be an momentum, because if the electron moves at velocity c its mass is

$$\text{a) } m_e = m_{e0}.\frac{1}{\left(1-\frac{v^2}{c^2}\right)^{\frac{1}{2}}} = \frac{m_{e0}}{\left(1-\frac{c^2}{c^2}\right)^{\frac{1}{2}}} = \frac{m_{e0}}{0} \to \infty \text{ ; b) } P_e = \infty.c; \qquad (1.13\text{-}3)$$

which fact speaks that the expression $\lambda_0 = h \big/ m_{e0}.c$ is only for intermediate computations, while the length of wave λ_0 has the value

$$\lambda_0 = \frac{h.c}{m_{e0}.c^2} = \lambda_k = 2.42.10^{-13}\,m \qquad (1.13\text{-}4)$$

called Compton's length of wave λ_k.

EMPHASIS. Since e_0^- and e_0^+ are at rest (v = 0), and the photons generated by them are in motion at velocity *c*, it follows that: the substance out of which are formed e_0^- and e_0^+, which are at rest, is carrier not only of anything at rest, but it is also carrier of the movement, but at e_0^- and e_0^+ it does not manifest. I. e. *substance is the resource of motion as well*.

1.13.2. At velocity $v_e < c$

It has been experimentally proved that the result from the interaction of an electron e^+ and a positron, e^+ at velocities $v_e < c$, depending on conditions, are protons (proton *p* and antiproton $\overline{p}$) or neutrons (neutron *n* and antineutron $\overline{n}$), as follows

a) $e^- + e^+ \to e_0^- + e_0^+ + (p + \overline{p})$; b) $e^- + e^+ \to e_0^- + e_0^+ + (n + \overline{n})$; (1.13-5)

whose internal energies and masses according to (1.3-19) are

a) $W_{po} = W_{\overline{p}0} = W_{e0}\left[\left(1-\beta_p^2\right)^{-1/2} - 1\right] = q_e^2.k_e\left[\left(1-\beta_n^2\right)^{-1/2} - 1\right] = W_{HE}$;

b) $m_{e0} = m_{p0} = \dfrac{W_{HE}}{c^2}$; (1.13-6)

a) $W_{n0} = W_{\overline{n}0} = W_{e0}\left[\left(1-\beta_n^2\right)^{-1/2} - 1\right] = q_e^2.k_W\left[\left(1-\beta_n^2\right)^{-1/2} - 1\right] = W_{HE}$;

b) $m_{n0} = m_{\overline{n}0} = \dfrac{W_{HE}}{c^2}$; (1.13-7)

Evidently, the kinetic (magnetic) energies of the accelerated electrons e^- and positrons e^+ have also been reconstructed (converted) into electromagnetic particles, protons and neutrons. The proof that they are electromagnetic particles are the facts:

First. Their masses and energies are:

a) $m_p = m_{\overline{p}} = m_{p0}\left(1-\beta_0^2\right)^{-1/2}$; b) $W_p = W_{\overline{p}} = m_p.c^2$; $\beta_p = \dfrac{v_p}{c}$; (1.13-8)

a) $m_n = m_{\overline{n}} = m_{n0}\left(1-\beta_n^2\right)^{-1/2}$; b) $W_n = W_{\overline{n}} = m_n.r^2$; $\beta_n = \dfrac{v_n}{c}$; (1.13-9)

Second. Their kinetic energies are magnetic, and are:

a) $W_{kp} = W_{hp} = W_p - W_{p0} = (m_p - m_{p0}).c^2$;

b) $W_{kn} = W_{Hn} = W_n - W_{n0} = (m_n - m_{n0}).c^2$; (1.13-10)

In interaction between p and $\overline{p}$ or n and $\overline{n}$ they are annihilated and photons are created with energies, frequency and length of the waves

a) $m_p + m_{\overline{p}} \to 2.\gamma_p$; b) $W_{p0} + W_{\overline{p}0} = 2.h.\nu_p$;

c) $\lambda_p = \dfrac{c}{\nu_p} = \dfrac{h.c}{m_{p0}.r^2} = \dfrac{h}{m_{p0}.c} = \lambda_{kp}$. (1.13-11)

where the length of wave $\lambda_p = \lambda_{kp}$ is called Compton's length of the proton.

By analogy, in any annihilation between a particle and an antiparticle with mass m_T it is possible to derive a Compton's length of wave λ_{kp} of the particle.

$$\lambda_{KT} = \frac{h.c}{m_{T0}.c^2} = \frac{h}{m_{T0}.c}\ ; \qquad (1.13\text{-}12)$$

This method also motivates the corpuscular-wave dualism, which is real for elementary particles, which can be restructured from material into field structure (form) of the electromagnetic matter.

In this respect it also motivates that matter (the energy and the mass) is quantized, and is homogenous and electromagnetic.

1.14. Gravitational fields and forces of electrons

1.14.1. When an electron is at rest: $v_e = 0$

The mass of the electron $m_{e0} = q_e^2.k_e$ (1.3-3) generates gravitational field

$$\vec{G}_{e0} = -\frac{m_{e0}.\gamma}{r^2}.r_0 = -\frac{q_e^2.k_e.\gamma.\vec{r}_0}{r^2}\ ; \qquad (1.14\text{-}1)$$

where: γ is the gravitational constant; q_e - electric charge $q_e \neq 1{,}6.10^{-19} C$ of the electron.

Since, in general, the electric charge is quantized, it can be said that $\vec{G}$ is quantized, too.

The density of the energy w_{Ge0} and the mass m_{Ge0} of the gravitational fields are

a) $w_{Ge0} = \dfrac{G_{e0}}{2.\gamma}$; b) $m_{Ge0} = {w_{Ge0}}/{c^2}$; (1.14-2)

The full gravitational energy of the electron at $v = 0$ is

a) $W_{Ge0} = \int_{r_{e0}}^{\infty} w_{Ge0}.dV = q_e^4.k_{G0}$; b) $k_{G0} = \gamma\left(24.\pi.\varepsilon_e^2.r_e^2.c^4\right)^{-1}$; (1.14-3)

The gravitational mass of the electron at $v = 0$ is

$$m_{Ge0} = \frac{W_{Ge0}}{c^2} = \frac{q_e^4}{c^2}.k_{G0}\ ; \qquad (1.14\text{-}4)$$

It is evident from (1.14-3) and (1.14-4) *that in its essence (nature) the gravitational field is generated by electric charge q_e at uniform power, which is always positive* $q_e^{2.n} > 0$. **That is why the gravitational field is unipolar**.

The relation of the electric energies and masses relative to the gravitational ones is

$$\frac{W_{e0}}{W_{Ge0}} = \frac{m_{e0}}{m_{Ge0}} \approx 4.17.10^{42}\,; \qquad (1.14\text{-}5)$$

1.14.2. At velocity *v* << *c* of the electron

At velocity $v \neq 0$, a magnetic field is generated around the electron with energy $W_{не}$ (1.3-8) and mass $m_{не}$ (1.3-9) and, respectively, a gravitational field $\vec{G}_{не}$ and energy $W_{Gнн}$

$$\text{a) } \vec{G}_{не} = -\frac{m_{не}.\gamma.\vec{r}_0}{r^2}\,; \text{ b) } m_{Gнн} = \frac{W_{Gнн}}{c^2}\,; \qquad (1.14\text{-}6)$$

1.14.3. At velocity *v* < *c* of the electron

Here the mass of the electron is

$$m_E = m_{e0} + m_{не} = m_{e0}\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} \qquad (1.14\text{-}7)$$

The gravitational field of the electron and its energy are

$$\text{a) } \vec{G}_{ev} = \vec{G}_{e0}\left(1 - \frac{v^2}{r^2}\right)^{-1/2}\text{; b) } W_{Gev} = W_{Ge0}\left(1 - \frac{v^2}{c^2}\right)^{-1/2}\,; \qquad (1.14\text{-}8)$$

1.14.4. Gravitational field of electromagnetic waves

The energy W_{EH} and the mass m_{EH} of sinusoid electromagnetic waves are pulsating in the time

$$W_{EH} = W_{EH0}.\sin^2 \omega t = \frac{W_{EH0}}{2} - \frac{W_{EH}}{2}.\cos 2.\omega t = W_{EH-} + W_{EH\sim} > 0\,; \qquad (1.14\text{-}10)$$

where: W_{EH0} and m_{EH0} are amplitudes of the energy and the mass.

The density of the mass of the electromagnetic wave is sum of the densities of the masses of the electric field E (1.3-2)b and of the magnetic field H (1.3-5)b

$$\rho_{EK} = \rho_E + \rho_H = \frac{\varepsilon_0.E^2}{2.c^2} + \frac{\mu_0 H^2}{2.c^2}\,; \qquad (1.14\text{-}11)$$

- to which correspond gravitational fields

$$\vec{G}_{\rho EH} = \vec{G}_{\rho E} + \vec{G}_{\rho H} = -\frac{\rho_E.\gamma.\vec{r}_0}{r^2} - \frac{\rho_H.\gamma.\vec{r}_0}{r^2}\,; \qquad (1=14\text{-}12)$$

which are also sinusoid – pulsating ($\sin^2 \omega t = \frac{1}{2}(1 - \cos 2\omega t)$).

The mean mass of one wave for time $T_0 = \frac{1}{\nu}$ or for the length of one wave is

$$\tau_{мен} = \frac{W_{EH}}{\lambda.c^2}\,; \qquad (1.14\text{-}13)$$

(1.4-13) implies that the gravitational field of mass in the form of a rod whose diameter D_v of the cross-section S_v of the wave is much smaller than the length

$l_v = n.\lambda_v$ of a flux of n waves, i. e. $l_v >> D_v$, is

$$\vec{G}_0 = \vec{G}_{\text{тен}} = -\frac{\tau_{\text{мен}}.\gamma}{2}.r_0 = \vec{G}_{v0} - G_{v0}.\cos 2\omega t > 0; \qquad (1.4\text{-}14)$$

where

$$G_{v0} = -\frac{\tau_{\text{мен}}.\gamma}{2.r}; \qquad (1.4\text{-}15)$$

is the amplitudinal value of the gravitational field of the mean value of the mass of the electromagnetic field of the wave.

It is evident from (1.4-14) that the gravitational field of the electromagnetic waves *is unipolar and pulsating.*

In this sense, if it is described relative to an axis of time, which is at a positive distance from $E \to \Delta E = \frac{E_0}{2}$ *and from* $H \to \Delta H = \frac{H_0}{2}$, *respectively, it can be treated as a sinusoid gravitational wave*, **which is inseparable from the electromagnetic wave and moves at its velocity**.

Because of their linear mass $\tau_{\text{мен}}$, the electromagnetic waves generate gravitational fields (1.4-15) and enter into force interactions with other gravitational fields. This is the explanation why a beam of light from a remote star is attracted by the sun.

Thus, it has been ascertained for a gravitational field that:

First. **It cannot exist without the mass of material or field electromagnetic matter which generates the gravitational field.**

Second. **It is electromagnetic - secondary electromagnetic field, which is only unipolar.**

Third. Since the independent field waves require bipolarity of their amplitudes, **then because the gravitational field is only unipolar, it is impossible for independent gravitational waves to exist without an electromagnetic mass (energy) to carry and generate them.**

1.15. Essence and consequences with Planck's constant

As it has already been pointed out in paragraph 1.7.25 and 1.13.1, it follows that at 1.5.1., in annihilation of an electron e_0^- and a positron e_e^+ at $v \approx 0$, photons are created $\left(e_0^- + e_0^+\right) \to 2.\gamma$ whose length of wave coincides with the length of Compton's wave $\lambda_k = 2.42.10^{-13} m$ (1.13-4), which in essence is electromagnetic, and Planck's constant determined by this reaction (interaction) is

$$h = \frac{m_{e0}.c^2}{\nu} = \frac{W_{e0}}{\nu_k} = \frac{q_e^2.k_e.c^2}{\nu_k} = q_e^2.k_e.c.\lambda_k = \frac{electromagnetic\ energy}{frequency}$$

$$\to [J, S]; \qquad (1.5\text{-}1)$$

By analogy, for protons *p* and neutrons *n*, which at annihilation generate photons with relevant Compton's lengths of waves and frequencies

a) $p_0 + \overline{p}_0 \to 2.\gamma_{\rm p}$; b) $n + \overline{n}_0 \to 2.\gamma_{\rm n}$;

c) $2.m_{\rm p0}.c^2 = 2h.\nu_{\rm p}$; d) $2m_{\rm p0} = 2.h.\nu_{\rm n}$ (1.5-2)

a) $\lambda_{\rm kn} = \dfrac{h.c}{m_{\rm n0}.c^2} = \dfrac{h}{m_{\rm n0}.c} = 13{,}19.10^{-16}\,m$; b) $\nu_{\rm pk} = \dfrac{r}{\lambda_{\rm kp}} = 2.27.10^{15}\,Hz$;(1.5-3)

a) $\lambda_{\rm kn} = \dfrac{h.c}{m_{\rm no}.r^2} = \dfrac{h}{m_{\rm n0}.c} = 13.19.10^{-16}\,m$; b) $\nu_{\rm nk} = \dfrac{e}{\lambda_{\rm kn}} = 2{,}274.10^{15}\,Hz$;(1.5-4)

From where follows the physical essence of Planck's constant

$$h = \frac{m_{\rm p0}.c^2}{\nu_{\rm pk}} = \frac{m_{\rm n0}.c^2}{\nu_{\rm nk}} = q_{\rm e}^2.k_{\rm e}.c^2.\left[\left(1-\beta^2\right)^{-1/2} - 1\right] = \frac{electromagnetic\ energy}{frequency}$$

$$\to [J,S]; \qquad (.1.5\text{-}5)$$

It is evident from the above said, that in essence, *h* is constant only when the energy of electromagnetic waves is determined for a finite time interval of *n* periods $t = \dfrac{1}{\nu} - \tau = n.T_0$. *Id est Planck's constant can only be used for electromagnetic waves, as well as for Compton's ones, which are only electromagnetic waves with fixed frequency* ν_ψ *and length of wave* $\lambda_{\rm k}$. **The fact that is used with all elementary particles speaks that, essentially, it is implicitly agreed, that their essence is the same as the essence of the electrons: electromagnetic, and that they can restructure from material in field form and vice versa.**

1.16. The principle of action and counteraction is observed in electrodynamics as well

1.16.1. Introduction

In mechanics, Newton introduced the notions of action - the force $\vec{F}_{12}$ *which acts and which actually is the released energy* dW_{12}*, according to the principle of interaction, from body 1 to body 2, and the notion of counteraction - the force* $\vec{F}_{12}$ *which counteracts and which is the energy* dW_{21}*, which body 2 absorbs and which by absolute value is* $dW_{21} = dW_{12}$*, but is interpreted with opposite sign, i. e.*

a) $\vec{F}_{12} + \vec{F}_{21} = \dfrac{dW_{12}}{\rm dr}.\vec{r}_{012} + \dfrac{dW_{21}}{\rm dr}.\vec{r}_{021} = 0$; b) $\vec{r}_{012} = \dfrac{\vec{r}_{12}}{(\overline{\rm r}_{12})} = -\vec{r}_{021}$

c) $\vec{F}_{12} = -\vec{F}_{21}$; d) $W_{\rm F12} = -W_{\rm F21}$; e) $W_{\rm F12} + W_{\rm F21} = 0$ (1.16-1)

Since the force - "the action" - is the energy passed from object 1 to - 2 ($F = dW/dr$) for a unit of pathway (*r = 1*) in the process of interaction between them, and the same quantity of energy (force) W_{F12} as that absorbed (W_{F21}) by object 2 is called "counteraction" according to the notation c (1.16-1) then eq. (1.16-1) is only another form for notation of MPCME, or respectively, of the law for conservation of the energy and the mass in this concrete case.

It is exactly this circumstance that necessitates the affirmation that the principle of "action" and "counteraction" holds true in electrodynamics too, or in this sense PCME is in force for electrodynamics too, which is a fundamental principle long-known as being experimentally validated.

In the above definition of Newton's it is necessary to point out that the notions of action and counteraction refer only to actually exchanged energies and their corresponding forces.

Taking into account that

$$dW = \vec{F}.d\vec{r} = \vec{F}.\vec{v}.dt = \vec{v}.d\vec{P}\,; \qquad (1.16\text{-}2)$$

where the quantity

$$\text{a) } d\vec{P} = \vec{F}.dt = m.\vec{a}.dt = m.d\vec{v}\,;\ \text{b) } \vec{P} = \vec{F}.t = m.\vec{v}\,; \qquad (1.16\text{-}3)$$

is momentum, which is component and is derivative with regard to energy, i. e. in this sense it is a secondary quantity with regard to the energy, and indeed

$$\text{a) } dP = \frac{dW}{v}\,;\ \text{b) } \vec{P} = \frac{W}{v}.\vec{v}_0\,;\ \text{c) } \vec{v}_0 = \frac{\vec{v}}{|\vec{v}|}\,; \qquad (1.16\text{-}4)$$

according to Newton, the energy *dW* is measured through the work *dA*, as

$$\text{a) } dW = dA = F.d\vec{r} = \vec{v}.d\vec{P}\,;\ \text{b) } d\vec{r} = \vec{v}.dt\,; \qquad (1.16\text{-}5)$$

i. e. the force is

$$\text{a) } \vec{F} = \frac{dW}{dr}.\vec{r}_0\,;\ \text{or b) } \vec{F} = \frac{d\vec{P}}{dt}\,; \qquad (1.16\text{-}6)$$

Newton probably proceeded from the principle of simplicity and assumed (1.16-6), but because the notation (1.16-5) is in essence a notation of the law for conservation of the energy, too, for the concrete situation in the form

$$\text{a) } dW = \vec{F}.d\vec{r}\,;\ \rightarrow \text{b) } \vec{F} = \frac{dW}{dr} = \vec{r}_0\,; \qquad (1.16\text{-}7)$$

then, a *more general definition of the force is that through (1.16-6)a, and besides, in physics, energy is a notion of a higher rank as compared to the momentum.*

In this sense, the principle of action and counteraction as a consequence of the law for conservation of energy requires that the released energy (force) should be equal to the received (absorbed) one. And because each interaction in essence in a more general meaning is a collision, this circumstance requires that the perpendicular components of forces or these, which coincide with the axis connecting the two objects denoted as perpendicular, should observe the law for conservation of energy, i. e.

$$\vec{F}_{\perp 12} + \vec{F}_{\perp 21} = 0\,; \qquad (1.16\text{-}9)$$

because only they are carriers of exchanged energy in the collision, and there is no process in nature in which this is not observed (1.16-8).

EMPHASIS

THE FORMULATIONS SET FORTH ABOVE IMPLY THAT, SINCE IN ELECTRODYNAMICS AS WELL AS IN MECHANICS, WHICH IS A CONSEQUENCE OF ELECTRODYNAMICS, AT $V << C$, THE FUNDAMENTAL

PRINCIPLE OF CONSERVATION OF MATTER AND ENERGY (FPCME) HOLDS TRUE, AND THUS THE PRINCIPLE OF ACTION AND COUNTERACTION IS ALSO FULFILLED, WHICH IS A CONSEQUENCE OF FPCME; THIS FACT HAS NO ALTERNATIVE.

1.17. The relation of forces of interaction between elementary particles

Proceeding from the fact, that the energy of the elementary particle is $W_{ч} = m_{ч}.c^2$ and the formula for the force, as a derivative of this energy relative to the distance

$$\text{a) } \vec{F}_{ч} = \frac{dW_{ч}}{\mathrm{dr}}.\vec{r}_0 ; \rightarrow \text{b) } F_{ч} = c^2 \frac{dm_{ч}}{\mathrm{dr}} ; \qquad (1.17\text{-}1)$$

therefore, the relation between forces F_1 and F_2 of two particles with masses m_1 and m_2 is

$$\frac{F_1}{\mathrm{F}_2} = \frac{dW_1}{\mathrm{dr}} \Big/ \frac{dW_2}{\mathrm{dr}} = \frac{dW_1}{\mathrm{dW}_2} = \frac{c^2.dm_1}{\mathrm{c}^2.dm_2} = \frac{dm_1}{\mathrm{dm}_2} = \frac{m_1}{\mathrm{m}_2} ; \qquad (1.17\text{-}2)$$

The relation between the forces of interaction of the neutron (nucleon) *n* and the electron $n_2^{'}$ is

$$\frac{F_{\mathrm{n}}}{\mathrm{F}_{\mathrm{e}}} = \frac{m_{\mathrm{n}}}{\mathrm{m}_{\mathrm{e}}} = \frac{1.67.10^{-27}}{9.1.10^{-31}} = 1.83.10^3 ; \qquad (1.17\text{-}3)$$

which value is within the frames of known data.

1.18. Conclusion

1. The resource of elementary particles formation is only electromagnetic and is initial quantized principle in a material form; it can be assumed that it is in the form of bipolar independent electric charges: electron and positron.

2. The law for conservation of electric charges is the reason and the initial principle of the laws for conservation and restructuring (conversion) of energy and mass, which are only electromagnetic, but manifest as various structural states.

3. All natural phenomena (processes) are only restructuring of electromagnetic matter (energy and mass) from one state into another.

Chapter two
Material electromagnetic structures: substance

2.1. Atomic electromagnetic structure - Atom

The atom is the lowest level of material structures of material elementary particles; i. e. the atom is the lowest level of structure of the material electromagnetic matter.

The atom is a structure of one atomic nucleus A_N of nucleons around which moves a system of electrons $\sum e^-$ in orbitals. The symbol of atom is

$$A_T = A_N + \sum e^- \qquad (2.1\text{-}1)$$

2.1.1. Atomic nucleus - AN

The atomic nucleus is an electromagnetic structure of the nucleons protons *p* with a positive electric charge equal by value to the electrons ($q_p = q_e$) and neutrons without a manifested electric field $E_B = 0$, but the nucleons generate a secondary electromagnetic field - gravitational field.

According to Earnshaw's theorem, there cannot be a stable structure of a system through electrostatic forces only. That is why the nucleons, which are electromagnetic structural elements of the atomic nucleus, are in continuous finite motion within the nucleus. Due to this fact the nucleons generate alternating electromagnetic fields inside the nucleus; i. e. kinetic energies are generated by the magnetic fields and the internal electromagnetic waves. And due to this circumstance are generated not only the electrostatic force between the nucleons in the nucleus, but also magnetic ones or, generally speaking, electromagnetic forces. I. e. *the dynamic state of the nucleons in the nucleus is the reason for it to exist as one whole - in the form of a stable dynamic structure with a manifest electric charge and a field depending on the number of protons inside it. Or* **the internal state of the nucleus is not static, but dynamic.**

2.1.2. Electrons in the atom and emission of photons

The electrons in the atom are its dynamic structural elements according to the requirement of Earnshaw's theorem. They move at velocities v_e along elliptic orbitals, which are very close to a regular circle. They are kept around the nucleus by the centripetal force F_e, which is generated from the interaction of their electric charge q_e with electric field E_N, generated by the charge q_N of the nucleus, which when acting along the distance $d\vec{r} = v_e.dt$ upon the electron, performs work dA_e giving off the energy dW_e to it

a) $\vec{F}_e = q_e.\vec{E}_N$; b) $dW_e = dA_e = \vec{F}_e.d\vec{r} = \vec{F}_e.\vec{v}_e.dt = F_e.v_e.\cos\alpha_{FV}$ (2.1-2)

There is an essential peculiarity here, as follows.

Case A. *When the angle* α_{FV} *between the force* $\vec{F}_e$ *and the velocity* $\vec{v}_e$ *is*

$\alpha_{FV} = \pi/2$, *the force does not off energy*

$$dW_e = F_e.v_e.\cos\pi/2 = 0; \quad (2.1\text{-}3)$$

but only changes its direction along the orbital. In case A the electron moves stably along the orbital, because its magnetic (kinetic) energy

$$W_{не} = W_{ke} = \frac{m_{e0}.v_e^2}{2} = const; \quad (2.1\text{-}4)$$

Case B. *When the angle* $\alpha_{FV} \neq \pi/2$ (2.1-5)

Two states are possible here

B.1. $\alpha_{FV} < \pi/2 :\rightarrow$ a) $\cos\alpha_{FV} > 0 ; \rightarrow$ b) $dW_e = F_e.v_e.\cos\alpha_{FV} > 0$; (2.1-6)

The force F_e *increases the magnetic (kinetic) energy* W_{Hei} *of the electron, which is on the* i^{th} *orbital with radius r of value*

a) $W_{hej} = W_{hei} + \Delta W_e = \frac{m_{e0}.v_{ei}^2}{2} + \Delta W_e$; b) $v_{ej}^2 = V_{ei}^2 + \frac{2.\Delta W_e}{m_{e0}}$;

c) $\Delta W_e = \int_{r_i}^{r_j} dW_e$; (2.1-7)

and because of its increased velocity to v_j*, its kinetic energy increases as well to* $W_{kj} = W_{нei} > W_{ki} = W_{нei}$. *However, by taking into account the role of the law for conservation of the sum of the kinetic energy* W_k *and the potential* W_p *energy*

$$W_k + W_p = K = const; \quad (2.1\text{-}8)$$

because when W_k *increases from* W_{ki} *to* W_{kj} *according to (2.1-7, the potential energy of the electron must decrease from* W_{pi} *to* W_{pj}*, i. e. the radius of the orbital must increase from* r_i *to* r_j*. This is the essential, primary reason for the orbital to change.*

But there is another explanation, too, which in essence is the previous one, but using the centrifugal acceleration $a_u = v^2/r$, which at velocity $v_i < v_j$ and $r_i < r_j$ has values $a_{cci} = v_i^2/r$, and the force of attraction $F_{ei} = m_{e0}.a_{cci}$ is smaller than the centrifugal force at velocity $v_j - F_{ecj} = m_{e0}.a_{ccj}$, due to which the electron moves to a higher orbital *j*.

B.2. $\alpha_{FV} > \pi/2 :\rightarrow$ a) $\cos\alpha_{FV} < 0 ;\rightarrow$ b) $dW_e = F_e.v_e.\cos\alpha_{FV} < 0$; (2.1-9)

As a result of (2.1-9) the kinetic (magnetic) energy of the electron decreases, and hence its velocity decreases and becomes

$$v_{en}^2 = v_{ei}^2 - \frac{2.\Delta W_e}{m_{e0}}; \quad (2.1\text{-}10)$$

Taking into consideration the law (2.1-8), its potential energy must increase from W_{pi} to W_{pn}, respectively the electron must move to a lower orbital with a radius

$r_n < r_i$. and here, an explanation can be given in centrifugal or centripetal accelerations.

2.1.2.1. Emphasis

The described modes of the electron are determined in essence by external conditions.

α) When the atom absorbs electromagnetic energy (photon) from the outside, its kinetic (magnetic) energy increases and it moves to a higher orbital.

β) When the external energy state of the photon gas outside the atom becomes equal to the one inside the atom or in exchange between the energy of the atom and the energy of external environment. Because of this condition, the electrons of the atom always emit and absorb photons, according to Kirchhoff's of 1860.

γ) In a lower external energy state of the photon gas dominates the emission of photons from the atom outwards.

θ) In deformation of the orbitals of the electrons by external factors (forces of pressure or extension) photons are emitted by the atoms.

According to Kirchhoff's law of 1860, in a balanced state, the relation of the emitted W_L to the absorbed W_k radiation electromagnetic energy, about which it is known today that it is in the form of a photon gas, does not depend on the nature of the substance, but only on the frequency ν and temperature T, i. e.

$$k_{LK} = {W_L}/{W_k} = f(\nu.T) = const\ ; \qquad (2.1\text{-}11)$$

Max Planck in 1900 proved that the energies W_L and W_k were emitted in the form of portions (quanta) of electromagnetic waves (photons) for time τ and at velocity $c = const.$, i. e. with length $l_0 = \tau . c$.

In these conditions, therefore, the photons are characterized by energy W_f, mass m_f, momentum $\vec{P}_f$ and force $\vec{F}_f$, as follows

$$\text{a) } W_f = h.\nu\ ;\ \text{b) } m_f = {W_f}/{c^2}\ ;\ \text{c) } \vec{P}_f = {W_f}/{\vec{c}_0}\ ;$$

$$\text{d) } \vec{F}_f = \frac{dW_f}{dr}\vec{r}_0 = \frac{dW_f}{c.dt} = \frac{d\vec{P}_f}{dt}\ ;\ \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}\ ; \qquad (2.1\text{-}12)$$

i. e. the energy of the photon has the features of the kinetic (magnetic) energy of the electrons (the bodies). That is why the energy of the photons, respectively the photons themselves, are the outcome of the electrons, and they generate pressure p and can perform work, as follows

$$dA_f = \vec{F}_f.d\vec{r} = \frac{dW_t}{dr}.\vec{r}_0.d\vec{r} = dW_t = \frac{d\vec{P}_t}{dt}.d\vec{r} = \vec{p}.\vec{c}\ ; \qquad (2.1\text{-}13)$$

Or, in essence, the emitted energy W_L and the absorbed energy W_K are electromagnetic, in their essence they are electromagnetic waves of portions which are called photons or they can also be called kinetic energies.

The frequencies of the photons, depending on the conditions can be different. With frequencies below $10^{12} Hz$ they are called thermal radiation (carriers of thermal

energy). With higher frequencies up to $10^{16}Hz$, they are light beams and so forth. What is essential, is that these energies are kinetic but emitted as portions (quanta - photons) and they are emitted only at wave velocity c and for this in force is the Doppler effect, and hence for their energy relative to a moving observer - inertial frame of reference IFR - K, at constant velocity v.

2.1.2.2. Consequence for the atoms from the emission and absorption of photons by electrons and atomic nuclei

Photons are portions (quanta) of electromagnetic (kinetic) energy, emitted or absorbed by the internal electromagnetic energy of the atom, and the substance is a system of atoms interrelated in one whole, which is called a body. Isaac Newton in his book "Optics" in 1704 argued about the bodies, but these arguments are in force for the atoms and molecules as well. He stated:

"All bodies emit and absorb light."

"The bodies convert into light, and the light into bodies."

"These are normal natural phenomena."

These statements, described by an updated text, taking into consideration that light is electromagnetic energy in the form of electromagnetic waves and is the sum of photons with energy $W_{\mathrm{f}} = h.\nu$, read as follows:

"All bodies emit and absorb electromagnetic energy in the form of photons."

"The bodies convert into electromagnetic energy (photons), and the photons - into bodies."

"These are normal natural phenomena."

These statements by Newton were made into a law by Kirchhoff in 1860 (2.1-11).

The internal kinetic (electromagnetic) energy of the atoms is accumulated: a) in the form of magnetic energy W_{ke} of the moving electrons in orbitals and b) in the form of kinetic energy W_{kn} of the nucleus, as a result of the movements of the nucleons inside the nucleus. The sum

$$W_{\mathrm{ka}} = W_{\mathrm{kn}} + W_{\mathrm{ke}}; \qquad (2.1\text{-}14)$$

is proportional to the temperature of the environment of the atoms in a state of thermal (energy) balance.

According to M. Planck, the atoms, at intervals of time Δt, continuously emit photons at velocity c, energy W_f and generate momentums $\vec{p}_{\mathrm{fi}}$, and forces according to (2.1-12), and in a general case, the directions of the photons (the momentums $\vec{p}_{\mathrm{f}}$) and the values of the frequencies, energies, momentums and forces are different. Because of this the resultant sums of $\vec{p}_{\mathrm{fi}}$ and $\vec{F}_{\mathrm{fi}}$ are different for a unit of time $T_i = 1$, with equal values of the sum of energies W_{fi}, varying between two extreme cases, as follows: a) from a case when all momentums are equidirectional to $\vec{p}_{\max}$, to b) a case when all $\vec{p}_{\mathrm{fi}}$ mutually compensate and their sum is $\vec{p}_{\mathrm{fmin}} = 0$. I. e. the mean, most probable sum of the momentums $\vec{p}_{\mathrm{fm}}$, and respectively of the forces $\vec{F}_{\mathrm{fm}}$, at temperature $T > 0\ K$ *is*

a) $\vec{P}_{\text{fmin}} > \vec{P}_{\text{fm}} > 0$; b) $\vec{F}_{\text{fmax}} > \vec{F}_{\text{fm}} > 0$; (2.1-15)

At $T > 0\ K$ and the conditions (2.1-15) for a unit of time or for a given interval of time τ in reality there is always force $\vec{F}_{\text{fm}} \neq 0$ acting upon the atom in indeterminate direction.

Since the atom also continuously absorbs photons, which generate the same form of results as of momentums $\vec{P}'_{\text{fm}}$ and forces $\vec{F}'_{\text{fm}}$, which are in the direction of their velocity $\vec{c}$, i. e. $\vec{F}_{\text{f}} \neq 0$ and $\vec{P}'_{\text{f}} \neq 0$. In these conditions, since $\vec{F}_{\text{f}}, \vec{P}_{\text{f}}\ u\ \vec{F}'_{\text{f}}\ u\ \vec{P}'_{\text{f}}$ act upon the atom in the same interval of time, say τ , for this time, their sum acts upon the atom

$$\vec{F}_{\text{fR}} = \vec{F}_{\text{fm}} + \vec{F}'_{\text{fm}} \neq 0 \text{ ;} \quad (2.1\text{-}16)$$

and this resultant force $\vec{F}_{\text{fR}}$ continuously, at intervals of time Δt_{i}, for time τ acts upon the atom with mass m_{AT} generating its acceleration $\vec{a}_{\text{AT}}$, velocity $\vec{v}_{\text{AT}}$, and rendering to it kinetic energy ΔW_{kat} as follows

$$\text{a) } \vec{a}_{\text{AT}} = \frac{\vec{F}_{\text{fR}}}{\text{m}_{\text{AT}}} \neq 0 \text{ ; b) } \vec{v}_{\text{AT}} = \vec{a}_{\text{AT}}.\tau_{\text{i}} \text{ ; c) } \Delta W_{\text{KAT}} = \frac{m_{\text{AT}}.v_{\text{AT}}^2}{2} \text{ ;} \quad (2.1\text{-}17)$$

Because the forces are in different directions for every interval of the time τ_{i}, they generate continuous oscillating motions of the atoms. I. e. **a general conclusion, a law, follows that the atoms of the substance (gas, liquid or solid body) are always in oscillating movements, which depend on temperature - T.** In this respect these oscillating movements are called thermal, and their energy is called thermal energy, which is electromagnetic, but because of the low frequency of the photons, it is called thermal.

But because the amplitude $A_0 = r_0$ of the oscillations of the atoms within the structure of the system called substance, which atoms are its structural elements, they are connected with the whole (the substance) by relevant structural links (forces), which limit the amplitude $A_0 = r_0$ of oscillations.

Here this question can be considered in the following aspect of two forces.

First. Force of Lennard-Jones - force of cohesion F_{e} .

The forces between the molecules of the substance are called in mechanics forces of cohesion, which are electromagnetic forces resulting from the pulsating electromagnetic fields of the atoms (the molecules) because in dynamic aspect (due to the movement of the electrons and due to the movements of their nuclei) they generate pulsating fields (waves) (irrespective of this, at the same time, they emit photons). It is exactly these fields (waves) that generate electromagnetic potential *U*, which is called Lennard-Jones potential, whose derivatives along *r* give the values of forces of Lennard-Jones $\vec{F}_{\text{L}}$ between the atoms (the molecules) depending on the distance *r*, as follows

$$\text{a) } U = \frac{\alpha}{r^{12}} - \frac{\beta}{r^6} \text{ ; } \rightarrow \text{ b) } \vec{F}_{\text{L}} = \frac{dU}{dr}.\vec{r}_0 = -\frac{\alpha.\vec{r}_0}{\text{r}^{13}} + \frac{l.\vec{r}_0}{\text{r}^7} \text{ ;} \quad (2.1\text{-}18)$$

where: α, β, a and b are respectively concrete physical constants.

Second. The resultant force $\vec{F}_{\mathrm{fR}}$ (2.1-16) from the emission and absorption of photons

For convenience, in qualitative analysis, without violating the general inferences, the force $\vec{F}_{\mathrm{fR}}$ is reduced to a schematic description, in which:

a) The force is approximated in time as a sinusoid.

b) The amplitude of the force is described as a constant, which is proportional to temperature $A_0 = \alpha.T \rightarrow \left[J.m^{-1}\right]$. The reason for this approximation is consequence of the fact that the density of the energy of photons w_f, which is kinetic (electromagnetic) energy and the temperature T are linearly dependent (related) for the normal range of temperatures

$$\text{a) } T = \beta.w_{\mathrm{f}} = \beta\sum_{1}^{n} W_{\mathrm{fi}}\ ; \rightarrow \text{b) } A = \alpha.T = \alpha.\beta.w_{\mathrm{f}} = k_{\mathrm{f}}.w_{\mathrm{f}}\ ;\ k_{\mathrm{f}} = \alpha.\beta\ ; \text{(2.1-19)}$$

in these approximations, the force F_{fR} is notated in the form

$$F_{\mathrm{fR}} = A_0.\sin\omega_0 t \neq 0\ ; \qquad \text{(2.1-20)}$$

In the above conditions, the sum of $F_{\mathrm{L}} \approx const$. plus F_{fR} give the resultant force F_{c} of cohesion of the perpetually oscillating molecule (atom) in the substance

$$F_{\mathrm{c}} = F_{\mathrm{L}} + F_{\mathrm{fR}} = F_{\mathrm{L}} + A_0.\sin\omega_0.t = F_{\mathrm{L}} + \gamma.T_0.\sin\omega_0.t\ ; \qquad \text{(2.1-21)}$$

This force F_e is the known from mechanics force of cohesion, which is electromagnetic force. Because F_L is almost constant and little depend on the temperature T, and F_{fR} depends proportionally on T and, moreover, it changes its value and direction depending on the time. Due to this circumstance when we assume that there are moments of time, in which F_L and F_{fR} have the same direction along a straight line for one cycle (period) of F_{fR}, then the resultant force of cohesion in these conditions is pulsating, and at the moment t_1 when $\sin\omega_0.t_1 = -1$, $F_{\mathrm{e1}} = F_{\mathrm{L}} - A_0$, and at the moment t_2, when $\sin\omega_0 t = 1 \rightarrow F_{\mathrm{c2}} = F_{\mathrm{L}} + A_0$.

These effects result from the perpetual oscillating movement of the atoms (the molecules), which are

$$\text{a) at } \sin\omega_0.t_1 = -1\ ; \rightarrow \text{b) } F_{\mathrm{ci}} = F_{\mathrm{L}} - A_0 = F_{\mathrm{cmin}}\ ; \text{ c) at } \sin\omega_0 t_2 = +1\ ; \rightarrow \text{d)}$$

$$F_{\mathrm{c2}} = F_{\mathrm{L}} + A_0 = F_{\mathrm{cmax}}\ ; \qquad \text{(2.1-22)}$$

and this is the density of electromagnetic energy, i. e. the modules of elasticity of the substance are electromagnetic quantities.

It is exactly this force F_c of cohision that determines the modules of elasticity known from mechanics. For the modules of elasticity of Jung, we obtain the dimensionality:

$$\text{a) } E_0 = \frac{F_{\mathrm{c}}}{\mathrm{S}}\ ; \rightarrow$$

$$\text{b) } E_0 = \frac{F}{S} \rightarrow \left[\frac{J.m^{-1}}{m^2}\right] = \left[\frac{J}{m^3}\right] = \frac{energy}{volume} = w = energy\ of\ density\ ; \quad \text{(2.1-}$$

23)

It becomes apparent from (2.1-22) that, when the temperature increases to a value when, according to (2.1-22), in the force F_{c1}, i. e. at temperature T_k , from

$$\text{a) } F_{c1} = F_L - \alpha.T_k = 0\,; \rightarrow \text{b) } T_k = F_L \big/ \alpha\,;, \qquad (2.1\text{-}24)$$

the force binding the atom (molecule) to the substance is annulled and the molecule starts moving freely and independently of the state of the substance, whose structural element it was at temperature $T' < T_k$. Thus, the substance forms its gaseous state.

The analysis shows how the temperature determines the state of the substance. At temperature T_0 of the substance in relation to the critical temperature of evaporation T_k determines its state of:

$$\text{a) a solid body - } T_0 << T_k\,;\ \text{b) liquid - } T_0 < T_k\,;\ \text{c) gas - } T_0 > T_k\,; \qquad (2.1\text{-}25)$$

In all states of the substance, its atoms and the molecules emit and absorb photons (thermal energy).

2.1.3. Stefan-Boltzmann Law (1879-1884)

Stefan, in 1879, found out experimentally, and Boltzmann, in 1884, proved theoretically Stefan-Boltzmann law for the emitted thermal (radiating) energy, which states:

A unit of surface of body at temperature T emits radiating electromagnetic (thermal) energy for a unit of time (according to present physics, this energy's carriers are the photons, i. e. it is in the form of a photon gas), whose power is

$$\frac{dW_A}{dt}.\vec{c}_0 = \vec{P} = \vec{\Pi} = \sigma.T^4.\vec{c}_0 = \frac{w_A.\vec{c}}{4} = \left[\vec{E}.\vec{H}\right]:\vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}\,; \qquad (2.1\text{-}26)$$

where: σ is Stefan-Boltzmann coefficient in $\left[J.m^{-2}.S^{-2}.K^4\right]$; w - density of the emitted electromagnetic (thermal) energy; c - the velocity of movement of the density of electromagnetic energy (of the photons). $\vec{E}$ and $\vec{H}$ - electric and magnetic fields of the electromagnetic waves, whose vector product $\left[\vec{E}.\vec{H}\right]$ is called vector of Pointing - $\vec{\Pi}$.

From $\vec{\Pi}$ (2.1-26) we determine the temperature

$$T = \left(\frac{\Pi}{\sigma}\right)^{\frac{1}{4}} = \left(\frac{w_0.c}{4.\sigma}\right)^{\frac{1}{4}} = w_n^{1/4}.\left(\frac{c}{4.\sigma}\right)^{\frac{1}{4}} = k_\sigma.\omega_n^{1/4} : k_\sigma = \left(\frac{c}{4.\sigma}\right)^{\frac{1}{4}}; \qquad (2.1\text{-}27)$$

It is evident that the temperature is an electromagnetic quantity, proportional to the density of electromagnetic energy, which is called thermal basically for frequencies of photons below 10^{12} Hz, but the energies of photons at higher frequencies ($\nu > 10^{12}$ Hz) are also transformed into thermal energy, according to the law for conservation and conversion (restructuring) of the unitary in its essence (nature) energy, which is here in the form of photons (electromagnetic waves).

Some significant inferences follow from the above presentation, and they are also initial assumptions, or groundwork, for further interpretation of radiating energy,

which are:

First. For the electromagnetic quantity of temperature, it is the electromagnetic laws that hold true: the theory of Maxwell and its further development by M. Planck in 1900.

Second. The radiating electromagnetic (thermal) energy generates force $\vec{F}_{\text{n}}$ and pressure p_{n}, which are derivatives of the energy W_{n} relative to distance *r*, i. e.

$$F_{\text{n}} = \frac{dW_{\text{n}}.\vec{r}_0}{\text{d}r} = \frac{\Pi.dt.\vec{c}_0}{c.dt} = \frac{\sigma.T^4}{c}.\vec{c}_0 = \frac{w_0.\vec{c}}{4} = \frac{P_{\text{n}}}{4}.\vec{c}_0 ; \qquad (2.1\text{-}28)$$

Since the pressure $\vec{p}$ is a relation of force $\vec{F}$ on surface *S*, i. e. the force, which acts upon a unit of surface (*S = 1*), it follows:

Third. Maxwell pressures imply that the electromagnetic flux of energy $q = w.v_{\text{q}}$, respectively the flux q of thermal energy moves from places of higher density of energy w_1 (greater pressure p_1) to places at distance Δr of lower densities of energy $w_2 < w_1$ (smaller pressures $p_2 < p_{\text{i}}$) or from places of higher temperatures *T*, to places at distance Δr of lower temperatures $T_2 < T_1$.

Fourth. The third conclusion implies that:

a) the flux $\vec{q}$ of electromagnetic (thermal) energy through a unit of surface (*S = 1*) for a unit of time (*t = 1*) is

$$\vec{q} = w.\vec{v}_{\text{T}} ; \qquad (2.1\text{-}29)$$

where: w is the density of the radiating energy; $\vec{K}_{\text{T}}$ - the velocity of the radiating energy through the substance, where it is in the form of photons, which are emitted from one molecule (atom) to another.

2.1.3.1. Emphasis. In the substance, at $T > 0K$, each molecule (atom) emits in all directions (the force F_{fR} of (2.1-20), but the difference in the densities of the energies (the values of the temperatures) along the distance Δr) generates a flux of photons $\Delta\vec{\Pi}$ of (2.1-26), and as a result of this circumstance the unidirectional flux $\Delta\vec{\Pi}$ also superimposes upon the molecule. Because of this fact the molecule unidirectionally absorbs and emits the flux $q = \Delta\vec{\Pi}$, irrespective of that it already emits multidirectionally and is in oscillating movement, and, as a whole, w moves through the substance at velocity $v_{\text{T}} << c$.

b) The flux $\vec{q}$ is proportional to the relation of the difference Δw_{12} between the densities of the energies w_1 and w_2, where $w_1 > w_2$, which are at distance Δr_{12} one from another in direction *q*, relative to this distance Δr_{12} or, respectively, the temperatures $T_1 > T_2$

$$\vec{q} = -k_o.\frac{\Delta W_{12}}{\Delta \text{r}_{12}}.\vec{r}_0 = -\lambda.\frac{\Delta T_{12}}{\Delta \text{r}_{12}}\vec{r}_0 ; \qquad (2.1\text{-}30)$$

Here the sign is minus because w_{12} moves from the greater to the smaller value of the densities of the energies or of the temperatures.

When moving to derivatives of (2.1-30), we obtain

a) $\vec{q} = -k_o . \frac{dw}{dr} \vec{r}_0 = -\lambda . \frac{dT}{dr} \vec{r}_0$; → b) $\vec{q} = -k_w . gradw = -\lambda . qradT$;(2.1-31)

where the coefficients of proportionality k_w and λ have the following dimensionalities

a) $k_w \to \left[m^4 . S^{-1} \right]$; b) $\lambda \to \left[J . m . S^{-1} . K^{-1} \right]$; (2.1-32)

the coefficient λ, called thermal conductivity

The law

$$\vec{q} = -\lambda . \frac{dT}{dr} \vec{r}_0 \; ; \tag{2.1-33}$$

was ascertained experimentally by Fourier in 1822.

Fourier's law in a differential form for a flux through a surface *dS* and for time *dt* is

$$dq = -\lambda . gradT . dS . dt \; ; \tag{2.1-34}$$

Fifth. The radiating electromagnetic (thermal) energy performs work because according to (2.1-28) it generates force $\vec{F}$ and pressure $\vec{p}$, which is a relation of force *F* upon a unit of surface

$$\vec{p} = \frac{\vec{F}}{S} \; ; \tag{2.1-35}$$

The work *dA* of the force $\vec{F}$ is

$$dA = dW = \vec{F}_n . S . d\vec{r} = P_n . dV \; ; \; dV = S . dr \; ; \tag{2.1-36}$$

after it is integrated in the limits r_1 to r_2 at $S = const.$ the result is

$$A = W = S \int_{r_1}^{r_2} \vec{F}_n . d\vec{r} = P_n . S . (r_2 - r_1) = P_n . \Delta V \; ; \tag{2.1-37}$$

If for a piston of a cylinder with surface *S* and stroke $\Delta r_{12} = r_1 - r_2$ a constant pressure (force) $P_n = const.$ is maintained, work A is performed, i. e. the energy of the photons are restructured from wave energy into kinetic or mechanic energy, in observance of the law for conservation of the energy.

2.1.3.2. Emphasis

a) In this electrodynamic process (2.1-37) describing the performance of work by a photon gas, variable quantities of the distance (stroke of the piston) can also take part, such as the force $F = F(r)$, the density of the energy of the photons $w = w(r)$, respectively temperature $T = T(r)$ and pressure $P = P(r)$ along the distance (stroke of the piston) from r_1 to r_2. Note that this description is for really existing and acting quantities in a real, *not in an idealized process, i. e. it is not an idealized, non-existing process such as Carnot cycle.*

b) *It is evident, that the description of the process of performance of work is not probabilistic, but completely deterministic, i. e. the process of performance of work is deterministic – it does not depend on any probabilistic quantities.*

c) or the energy of the photon gas is described with real and deterministic parameters.

2.1.4. A brief systemization of the principal electromagnetic formulations (regularities).

These formulations are consequences of the theories of Isaac Newton, J. C. Maxwell and Max Planck:

2.1.4.1. The bodies (the molecules, the atoms), continually, at intervals of time, emit and absorb electromagnetic matter with relevant energies and masses in the form of photons.

2.1.4.2. The emitted and absorbed photons are in different directions and in different moments of time relative to the surface of the object (body, molecule or atom) of the energy exchange.

2.1.4.3. The energies (the masses) of the photons are with energies W_e multiple of the frequency.

2.1.4.4. The duration τ of the emission and absorption of the photons is short-lived - $\tau \approx 10^{-8} s$, and it is always done at electromagnetic velocity c, due to which the photons are in the form of a rod with length $l_0 = \tau.c \approx 10^{-8}.3.10^8 \approx 3m$.

2.1.4.5. The photons are field electromagnetic matter in the form of electromagnetic waves with frequency ν ; they have: energy W_f, mass m_f, gravitational field G_f generated by the mass m_f, momentum $\vec{P}_f$ and force $\vec{F}_f$, which generates photon pressure p_f, as follows:

a) $W_{fi} = h.\nu_i$; b) $m_{fi} = \frac{W_{fi}}{c^2}$; c) $\vec{G}_{fi} = -\frac{m_{fi}.\gamma}{r}$; d) $\vec{P}_{fi} = m_{fi}.\vec{c} = \frac{W_{fi}.\vec{c}_0}{c}$;

e) $\vec{F}_{fi} = \frac{d\vec{P}_{fi}}{dt} \approx \frac{W_{fi}.\vec{c}}{c.dt} \approx \frac{W_{fi}.\vec{c}_0}{c.\tau_i}$; f) $|P_f| = |\vec{F}_{fi}|$; (2.1-38)

where: γ is gravitational constant, in the nominator is r, not r^2, because in filiform bodies, the gravitational field is obtained at r.

2.1.4.6. Due to the continuous emission and absorption of photons by the bodies with $T > OK$, in the space between the bodies there are photons: photon gas with density of the energy

$$w_f = \frac{\sigma.T_i^4}{c} = \sum W_{fi} = h\sum \nu_i > 0 \; ; \qquad (2.1\text{-}39)$$

i. e. these photons collide with and are absorbed by the bodies, and the bodies at

$T_i > 0$ emit photons and so is formed the photon gas in the environment.

2.1.5. On quantizing in classical physics

In 1843, Michael Faraday discovered the law for conservation of electric bipolar charge, which is known today as an independent bipolar charge in the form of electron e^- and positron e^+.

At the present level of knowledge, we know about these independent electric charges that they are characterized by independent portions (quanta) of energies and masses, which are of electromagnetic nature.

When e^- and e^+ interact in relevant conditions, protons (p *and* $\overline{p}$) and neutrons (n and $\overline{n}$) are generated. This fact is the reason for the conclusion that the energies and the masses of the protons and neutrons are of electromagnetic nature, i. e. they are electromagnetic matter, whose structures are different from these of the electrons and positrons, but because the masses and their internal energies are much greater than those of the electron and positron, this is not referred to as quantizing as it is now for the energies of the electromagnetic waves relative to these of the photons.

Max Planck discussed the issues about photons when in physics the question of the electric charges was not of current concern; besides, the independent charges electron and positron were not yet discovered. Because of this, he was the first to pose the question of energy quantizing. This is why his achievement is of great importance for physics.

However, today, when we know the properties of the electron and positron, we can say that classical physics too has some features for quantizing of electromagnetic energies and masses.

2.2. Gravitation of substance: gravitation of bodies with volume V larger than zero ($V > 0$).

2.2.1. Electromagnetic masses and energies of electrons

A) At rest ($v \approx 0$; $v << c$)

a) $m_{e0} = q_e^2.k_e$; b) $W_{e0} = m_{e0}.c^2 = q_e^2.k_e.c^2$; $k_e = \left(4\pi\varepsilon_0.r_{e0}c^2\right)^{-1}$ (2.2-1)

B) At velocity $v < c$

a) $m_e.n_{e0}\left(1-\frac{v^2}{c^2}\right)^{-1/2}$; b) $Wle = W_{e0}\left[\left(1-\frac{v^2}{c^2}\right)^{-1/2}-1\right]$; (2.2-2)

2.2.2. Gravitation of electrons at velocity $v << c$

A) The gravitational potential of electron[3]

$$U_{\mathrm{G}} = \frac{m_{\mathrm{e0}}.\gamma}{r} = \frac{q_{\mathrm{e}}^2.k_{\mathrm{e}}.\gamma}{\mathrm{r}}; \qquad (2.2\text{-}3)$$

B) Gravitational field: secondary electromagnetic field

$$\vec{G}_{\mathrm{G}} = \frac{dU_{\mathrm{G}}}{\mathrm{dr}}.\vec{r}_0 = \frac{m_{\mathrm{e0}}.\gamma}{r^2}.\vec{r}_0; \qquad (2.2\text{-}4)$$

C) Density of the gravitational energy

$$w_{\mathrm{G}} = \frac{G^2}{2.\gamma} = \frac{m_{\mathrm{e0}}.\gamma}{r^4} = \frac{q_{\mathrm{e}}^2.k_{\mathrm{e}}^2.\gamma}{\rho^4} > 0; \qquad (2.2\text{-}5)$$

D) Gravitational energy and mass of the electron

$$\text{a) } W_{\mathrm{eG}} = \int_{r_{\mathrm{e0}}}^{\infty} w_{\mathrm{G}}.dV = \frac{m_{\mathrm{e0}}^2.\gamma}{\mathrm{r_{e0}}} = \frac{q_{\mathrm{e}}^4.k_{\mathrm{e}}^2.\gamma}{\mathrm{r_{e0}}}; \text{ b) } m_{\mathrm{eG}} = \frac{W_{\mathrm{eG}}}{\mathrm{c}^2}; \qquad (2.2\text{-}6)$$

E) The gravitational charge is the mass of the electron - m_{e0} (2.2-7)

F) Gravitational force

$$\vec{F}_{\mathrm{eG}} = -m_{\mathrm{e0}}.\vec{G}_{\mathrm{e}} = -\frac{m_{\mathrm{e0}}^2.\gamma.\vec{r}_0}{\mathrm{r}^2} = \frac{q_{\mathrm{e}}^4.k_{\mathrm{e}}^2.\gamma}{\mathrm{r}^2}.\vec{r}_0; \qquad (2.2\text{-}8)$$

G) The relation of W_{e0} relative to W_{eG} or of m_{e0} relative to m_{eG} is

$$k_{\mathrm{eG}} = \frac{W_{\mathrm{e0}}}{\mathrm{W_{eG}}} = \frac{m_{\mathrm{e0}}}{\mathrm{m_{eG}}} \approx 4.17.10^{42}; \qquad (2.2\text{-}9)$$

H) The considerations presented above motivate the unity between the Coulomb's law and Newton' gravitation for two electrons with charges $q_{e1} = q_{ei} = q_e$

$$\text{a) } \vec{F}_{\mathrm{e}} = \frac{q_{\mathrm{e1}}.q_{\mathrm{ei}}.\vec{r}_0}{4\pi\varepsilon_0.r^2} + \frac{q_{\mathrm{e1}}^2.q_{\mathrm{e2}}^2.k_{\mathrm{e}}^2.\gamma.\vec{r}_0}{r^2} = \vec{F}_{\mathrm{eq}} + \vec{F}_{\mathrm{eG}}; \text{ b) } \left|\vec{F}_{\mathrm{eq}}\right| >> \left|\vec{F}_{\mathrm{eG}}\right|; \qquad (2.2\text{-}10)$$

In the equations for the gravitation of the electrons, we should emphasize the fact that the electrons have a very small radius, and hence, a very small volume. Therefore, they are practically almost without any volume in relation to the bodies whose dimensions (volumes) are 10^6 times bigger or even more. *In this sense, in the gravitational interactions between the electrons they are practically between point-like (V = 0) objects. That is why the value of the level of the distance r is r^{-2}. That was Newton's idea, since he used the notion of mass as a point-like object, placed in the center of weight of the object to which the mass belongs.* In this case, the mass is only with its inertial and gravitational property of the object to which the mass belongs.

I. e. the above general formulae are for point-like objects a volume V = 0 (2.2-11)

---

[3] Here we should **point out the truth that about a century ago it was known that electrons generate gravitational field as well,** i. e. that electric charge generates gravitational field, too. **But physicists, up to this very day, have not paid due attention to this crucial scientific fact** which is the embryo of the theory of gravitation.

2.2.3. Gravitation of an object with a volume larger than zero: $V > 0$

2.2.3.1. General assumptions

In essence, all material objects have volumes different from zero.

It is useful to cite here the theorem for the gravitational field outside the volume of a spherical body as proved by Isaac Newton in 1686 (a year before "Principles…"), which states: "A spherical body of a homogenous density of the mass $\rho_m = const.$ and radius $R > 0$ and volume $V > 0$ generates gravitational filed in the space outside its volume, generated the mass m_R, if it is concentrated in a dimensionless point, which is placed in the center of the sphere."

In the above conditions, the nominator of the formula of the gravitational field (2.2-4) and force (2.2-8) has value two (2) only when the mass m is a dimensionless point (the body has a volume practically equal to zero), and therefore:

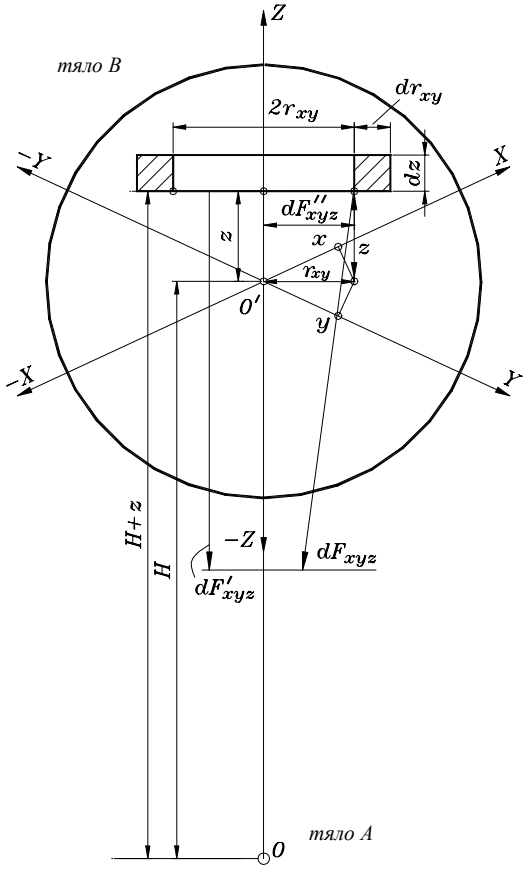
When computing the gravitational fields and forces of bodies with a volume larger than zero, what are all real bodies, it should be integrated for each point of the volume, in which the mass of this elementary volume of the body is $dm_E = \rho.V_i$, the distance is r_i; moreover, the gravitational field G_i relative to the attracting body, which is at distance r_i , is also the force of attraction F_i of a body with a spherical mass m_0

$$\text{a) } \vec{G}_{0i} = -\frac{m_0 \gamma}{r_i^2}.\vec{r}_0 \text{ ; b) } \vec{F}_i = dm_i.\vec{G}_{0i} = -\rho \frac{dV_i.m_0.\gamma.r_0}{r_i^2} ; \qquad (2.2\text{-}12)$$

It follows that the gravitational force between two ideally spherical bodies **A** and **B** with homogenous density of their masses are $\rho_A = \rho_B = \rho = const$, masses $m_A > 0$, $m_B > 0$ spherical volumes $V_A > 0$, $V_B > 0$ and radiuses $r_A > 0$, $r_B > 0$ at a distance between their centers $00' = H$ (according to Fig. 2.2.3.1) and with a coordinate system in the center of the body (the sphere) **B**, *in order to derive the force of attraction between the bodies **A** and **B** according to Newton's theorem, it is assumes that the body **A** is reduced at point O (Fig. 2.2.3.1) and the formula (2.2-12)b is applied for the force dF_{AB} between the body **A** (point 0) and the elementary volumes $dV = dx\,.\,dy\,.\,dz$ of the body **B** and is integrated for the volume of the body **B** with radius r_B.* In these conditions for the gravitational force between the bodies **A** and **B**, we have:

$$\text{a) } \vec{F}_{AB} = -m_A.\gamma.\rho.\iiint_{r_B}^{+r_B} \frac{(H+z)\left(x^2+y^2\right)^{1/2}.dx.dy.dz}{\left[x^2+y^2+(H+z)^2\right]} ;$$

$$\text{b) } F_{AB0} = -\frac{m_A.m_B.\gamma.\vec{r}_0}{H^2} ; \qquad (2.2\text{-}13)$$



- **Fig. 2.2.3.1.**

The formula of F_{AB} (2.2-13)a is derived by the following approach.

Considered are the spherical objects A (attracting body) and B (the body, which is attracted by A) in a coordinate system *xyz* with a beginning *0* in the center of the body B. The center of B is at distance **H** from the center of the spherical body **A**, which attract the body **B**.

Considered is one elementary ring of the body **B** with cross-section $dS = dr_{xy}.d_z$ at distance r_{xy} from the axis z in the plane *xy* and at distance Z form the beginning 0' of the coordinate system xyz (Fig. 2.2.3.1). The mass of this elementary ring is with volume $dV = 2\pi (x^2 + y^2)dS$ and is

$$dm_z = \rho.dV = \rho.2\pi\left(x^2 + y^2\right)dr_{xy}.dz$$

It is at distance $r_z^2 = \left[(H+z)^2 + \left(x^2 + y^2\right)\right]$ from the body **A**, in which circumstance upon the mass dm_z is generated gravitational force of $\vec{G}_0$ of the body A with mass m_0, and the volume *dV* of dm_z in this case is assumed to be zero. I. e. the case is reduced a gravitational force upon a point-like object. In this case the elementary force between the masses dm_z and m_0, which are at distance r_z is the same as with point-like objects

$$d\vec{F}_{xyz} = dm_z.\vec{G}_0 = -\frac{dm_z.m_0.\gamma}{r_z^2}; \qquad (2.2\text{-}14)$$

This force dF_{xyz} has projections:

a) upon the axis z it is

$$dF'_{xyz} = dF_{xyz}.\cos\alpha\left(H.z.r_z\right) = dF_{xyz}.\frac{(H+z)}{r_z}; \qquad (2.2\text{-}15)$$

which is the force of attraction of the mass dm_z relative to the mass m_0

b) upon the surface parallel to the plane determined by the axes xy but at distance z from it (from 0'), it is

$$dF''_{xyz} = dF_{xyz}.\sin\alpha(H.z.r_z) = dF_{xyz}.\frac{\left(x^2+y^2\right)^{1/2}}{r_z}; \qquad (2.2\text{-}16)$$

This force dF''_{xyz} exerts pressure upon its internal layer of the body B relative to the axis z.

The notation of the integral (2.2-13)a is of $d\vec{F}_{xyz}$ for the volume of the body B. And the notations of the integrals of $d\vec{F}'_{xyz}$ and $d\vec{F}''_{xyz}$ are

$$F'_{xyz} = -m_0.\rho.\gamma\iiint_{-r_0}^{+r_0}\frac{\left(x^2+y^2\right)^{1/2}.(H+z).dx.dy.dz}{\left[(H+z)^2+x^2+y^2\right]^{1/2}}; \qquad (2.2\text{-}17)$$

$$F''_{xyz} = -m_0.\rho.\gamma\iiint_{-r_0}^{+r_0}\frac{\left(x^2+y^2\right).dx.dy.dz}{\left[(H+z)^2+x^2+y^2\right]^{3/2}}; \qquad (2.2\text{-}18)$$

Until present time, these integrals have not been notated or solved. But they show that:

A) **as a matter of fact, the gravitational forces in real bodies with volume $V > 0$ are subjected not only to attraction, but also to pressure in direction of the axis, which connects the centers of the attraction and the attracting body.**

B) **The gravitational forces of attraction of bodies with volume $V > 0$, computed by the simplified method are more or less different from the real ones. This fact reflects upon the preciseness of Kepler's laws.**

C) **The force of attraction of the bodies, which have volume $V > 0$ strictly speaking is never inversely proportional to r^2, but always to $r^{2\pm\alpha}$ ($0 < \alpha << 1$), due to which the gravitational potential is inversely proportional to $r^{2\pm\varepsilon}$ ($0 < \varepsilon << 1$) as well. From this fact, according to Bertrand's theorem, the orbits of the planets are never closed ellipses, but are always open in the form of rosettes.**

2.2.3.2. Extreme models of gravitational interaction

Considered are two positions of a rod-body B with cross-section $S = 1.m^2$ and length 2.l, relative to the gravitational field of a spherical body with mass m_0 at distance H relative to the center of the rod.

a) **First position.** The rod (the body B) is perpendicular to the gravitational field $\vec{G}_0$ of the attracting body A, where

$$\vec{G}_0 = -\frac{m_0.\gamma}{r^2}.\vec{r}_0, \qquad (2.2\text{-}19)$$

according to Fig. 2.2.3.2a

The elementary mass $dm_x = \rho.dx$ of the rod is at distance x form its center *0*. The coordinate system *xy* is in the center *0* of the rod. The force dF_{xy}, with which the body A with a spherical mass m_0 attracts the mass dm_x of the rod (body B) is

$$d\vec{F}_{xy} = dm_x.\vec{G}_0 = -\rho.\frac{d_x.m_0.\gamma.\vec{r}_0}{\left(H^2+x^2\right)}; \qquad (2.2\text{-}20)$$

The projections of dF_{xy} upon the axes *Y* and *X* of the coordinate system are

$$\text{a) } dF_{yy} = -\rho.\frac{m_0.\gamma.H.dx}{\left(H^2+x^2\right)^{3/2}};\ \text{b) } d\vec{F}_{xx} = -\rho.\frac{m_0.\gamma.x.dx}{\left(H^2+x^2\right)^{3/2}}; \qquad (2.2\text{-}21)$$

From which, after integrating in the relevant limits, are obtained

$$\vec{F}_{ye} = \int_{-l}^{+l} dF_{yy} = -\rho.\frac{m_0.\gamma.2.l.\vec{r}_{0y}}{H\left(H^2+l^2\right)^{1/2}};\ \vec{r}_{oy} = \frac{\vec{y}}{|\vec{y}|}; \qquad (2.2\text{-}22)$$

$$\vec{F}_{xe} = \int_{l}^{0} dF_{xx} = -\rho.\frac{m_0.\gamma.l_0.\left[\left(H^2+l^2\right)^{1/2}-H\right]}{H\left(H^2+l^2\right)^{1/2}}.\vec{r}_{0x} : \vec{r}_{0x} = \frac{\vec{x}}{|\vec{x}|}; \qquad (2.2\text{-}23)$$

With the force $\vec{F}_{ye}$ the body A (the mass m_0) attracts the whole rod relative to itself along the direction of the axis Y at distance *H* between the body *A* and the body B (the rod).

The force $\vec{F}_{xl}$ is only for the one half of the rod and exerts pressure relative to its center. Such is also the force $\vec{F}'_{xe}$ on the other side of the rod, which presses this half relative to the center of the rod.

These forces $\vec{F}_{xl}$ and $\vec{F}'_{xl}$ generate deformation of pressure upon the rod with cross-section $S = 1$, as follows

$$\chi = \frac{F_{xl}}{S.E_0} = \frac{F_{xl}}{1.E_0}; \qquad (2.2\text{-}24)$$

where: E_0 is the module of elasticity of Jung for the material of the rod. I. e. the gravitational field of the body A, in addition to attracting the body B, generates pressure, which is trying to shorten the rod by

$$\Delta l = \chi.l; \qquad (2.2\text{-}25)$$

If we compute the gravitational force in this case between the objects A and B, which are assumed to be point-like objects, we obtain only the force of attraction with value

$$\vec{F}_{y0} = -\rho.\frac{2.l.m_0.\gamma}{H^2}.\vec{r}_{0y}; \qquad (2.2\text{-}26)$$

The relations of the real force of attraction $\vec{F}_{yl}$ (2.2-15) to the approximate force $\vec{F}_{y0}$ (2.2-19) is obtained

$$K'_{Fy} = \frac{F_{ye}}{F_{y0}} = \frac{H}{\left(H^2+l^2\right)^{1/2}} < 1; \qquad (2.2\text{-}27)$$

I. e. the computed real gravitational force of attraction between objects A and B, in this case is smaller than its value obtained by a simplified computation, as point-like objects.

b) **Second position**. The rod is parallel to the gravitational field of the body A (with mass m_0) which attracts the rod, according to Fig. 2.2.3.2.b.

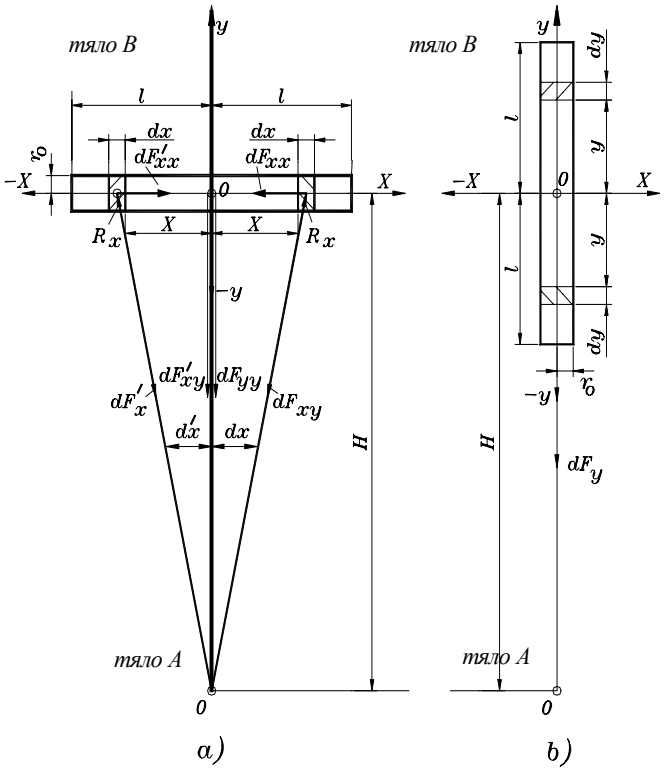
At distance y along the axis Y of the coordinate system xy, which is in the center of the rod O (Fig. 2.2.3.2.b) is the elementary volume $dV_y = S.dy$) which has elementary mass $dm_y = \rho.dV_y$, which is attracted by the body A, which is at distance b) from it with force $r_y = H + y$ of attraction of the whole rod – 2.l

$$dF_y = -dm_y.\vec{G}_{0y} =$$

$$-\rho.\frac{m_0.\gamma.dy}{r_y^2}.\vec{r}_{0y} =$$

$$= -\rho.\frac{m_0.\gamma.dy}{(H+y)^2}.\vec{r}_{0y};$$

(2.2-28)



- **Fig. 2.2.3.2**

The resultant force of attraction of the whole rod - *2.l* e

$$\vec{F}_y = \int_{-l}^{+l} dF_y = -\rho.\frac{2.l.\gamma.\vec{r}_{0y}}{H^2 - l^2}; \qquad (2.2\text{-}29)$$

The relation of F_y (2.2-22) to F_{y0} (2.2-19) is

$$K_f'' = F_y \Big/ F_{y0} = \frac{H^2}{H^2 - l^2} > 1; \qquad (2.2\text{-}3)$$

I. e. the real gravitational force of attraction of a rod, which is parallel to the gravitational field of the body, which attracts it, is greater than the computation and if assumed that the rod is a point-like object – without a volume or spatial dimensions.

If we consider a body B, which is an equilateral cross made of two identical rods as the previous one at right angle and is with a common center obtained by the superimposition of centers O of the two rods. Let one rod is perpendicular, and the other rod is parallel to the gravitational field of body A with mass m_0 and at distance H from the center 0 of the cross. The cross-sections of the rods are $S = 1$, and their lengths are $2.l_o$, i. e. as it was with the first and second positions, where we obtained attracting forces F_{yy} (2.2-15) and F_y (2.2-22).

Naturally, the attracting force of the cross (body B) is the sum of the forces F_{ye} and F_y. I. e. the attracting gravitational force of the body A with mass m_0 of the cross

with relevant mass, positioned in the form of a cross (body B) is

$$F_{\mathrm{k}} = F_{\mathrm{yl}} + F_{\mathrm{y}} = -\rho.m_0.2l.\gamma\left(\frac{1}{H\left(H^2+l^2\right)^{1/2}} + \frac{1}{H^2-l^2}\right); \tag{2.2-31}$$

where, according to the condition

$$\text{a) } H^2 > l^2; \rightarrow \text{b) } \left(H^2+l^2\right)^{1/2} = H^2 + \frac{1}{4}l^2; \tag{2.2-32}$$

after it is developed (2.2-24) under the condition of (2.2-24)b, the result is

$$F_{\mathrm{k}} = -\rho.m_0.2l.\gamma\left(\frac{1}{H^2}.\frac{8H^2-3l^2}{4H^2-3l^2-\frac{1}{4}l^4}\right); \tag{2.2-33}$$

This value of F_k refers to the solution as point-like objects, which is

$$F_{\mathrm{k}}^{'} = -\rho.\frac{m_0.4l.\gamma}{\mathrm{H}^2}; \tag{2.2-34}$$

we obtain

$$\frac{F_{\mathrm{k}}}{\mathrm{F}_{\mathrm{k}}^{'}} = \frac{8H-3l^2}{8H-6.l^2-\frac{r}{4}l^4} > 1; \tag{2.2-35}$$

Id est the precise computation of the gravitational force of attraction with taking into consideration that the volume V of the mass is different from zero $V > 0$ gives a little greater value of the gravitational force. This fact means that in order to obtain a more precise value of the gravitational force, by using the method (Newton's formula), the distance r between the centers of the bodies should not be exactly of second power (r^{-2}), but should be with a small α different from $2 - r^{2-\alpha}$, where

$$0 < \alpha << 1; \tag{2.2-36}$$

I. e. the formula (2.2-26) should be

$$F_{\mathrm{k}}^{''} = -\rho.\frac{m_0.4l.\gamma}{H^{2-\alpha}} = F_{\mathrm{k}}; \tag{2.2-37}$$

Or, in the most general case, because with a rod perpendicular to the gravitational field of the body, which attracts it, the real force F_{ye} (2.2-15) is smaller than its computation, when we assume that the rod is a point (2.2-19), the sign through α should be plus. *Therefore, in the most general case, depending on the form and position, the gravitational force with taking into consideration the form and the volume of the mass of the attraction, a body with mass m_T, is*

$$F_{\mathrm{G}} = -\frac{m_{\mathrm{T}}.m_0\gamma}{\mathrm{r}^{2\mp\alpha}} \neq -\frac{m_{\mathrm{T}}.m_0.\gamma}{r^2}; \tag{2.2-38}$$

At $V > 0$, upon the bodies acts not only a force of attraction, but there is always a force of pressure of the surface of the attracted body perpendicular to the axis of attraction, i. e. the axis (the straight line) which goes through the centers of the two bodies.

For example:

- The pressure upon the Earth, generated by the gravitational field of the Sun, has two frequencies; the first is from the rotation of the Earth round its axis and the second, from the movement of the Earth along its orbit round the Sun.
- In addition to this, pressure $\sigma_{Л}$ is created by the gravitational field of the Moon and it is with two frequencies.
- Moreover, similar pressures are created by the other planets as well.

These pressures should reflect upon the tectonic processes of the earth crust, too, that is to say they should intensify them. A question, which has not been interpreted so far, but it influences the tides in the oceans.

Taking into consideration Bertrand's theorem, which states:

Solely and only in a centrally symmetric Coulomb's potential $(-\frac{\alpha}{r^2})$ *and in random initial conditions, the orbits of the planets are closed ellipses. In a random central field, little as it differs from* $\frac{\alpha}{r^2}$ *the finite movement of the planets is not along a closed curve, but has the shape of a rosette.*

Proceeding from the known effects, these inferences follow:

First. The gravitational forces between two real bodies are always different from the forces which correspond to Coulomb's forces.

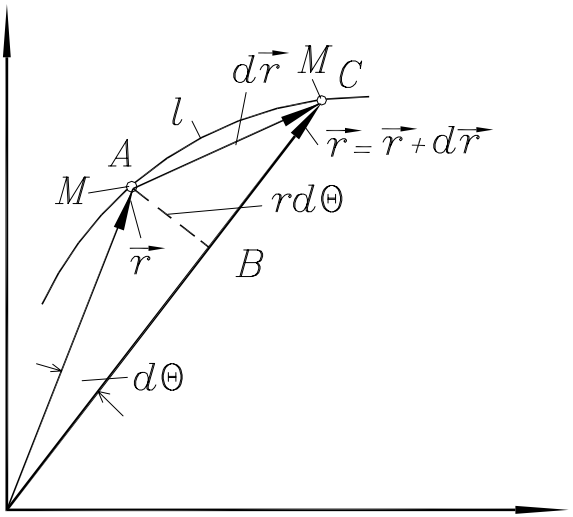
Second. The other cosmic bodies always influence the change of the gravitational forces between the planets and the Sun in real conditions, in result of which the resultant gravitational force significantly declines from the value, which it would have at Coulomb's potential.

Third. In result of the change of the mass depending on the velocities of the cosmic objects in aphelion or perihelion, the gravitational potential of the cosmic objects also changes relative to Coulomb's potential.

It is evident that the force F_{AB} (2.2-13)a has always a different value relative to the force $\vec{F}_{AB0}$ (2.2-13)b. Or, in other words, the gravitational forces between two real bodies (with volumes $V > 0$) or between two planets, whose forms are close to spheres, but never exact spheres, as well as with spherical bodies, their gravitational potentials are never equal to Coulomb's potential $(-\frac{\alpha}{r^2})$. *Because of this fact the orbits of the planets are always open, i. e. the planets according to Bertrand's theorem always move along rosettes.* And when taking into consideration the influence of the other planets too, the rosette effect increases.

2.2.4. Sector velocity is not constant

Sector velocity σ is equal to the change of the surface which the radius-vector of a moving point object M circumscribes for time dt related to a reference system with initial point 0 (Fig. 2.2.4.1). The material point M moves from point A with a radius-vector $\vec{r}$ for time dt (angle $a\theta$) to point C with radius-vector $\vec{r}` = \vec{r} + a\vec{r}$.



Фиг. 2.2.4.1.

The surface which the radius-vector circumscribes for time dt is

$$dS = dS` + dS`` = 0AB + ABC$$

or

$$dS = \frac{1}{2}.r.rd\theta + \frac{1}{2}.r.d\theta.dr \quad (2.2\text{-}40)$$

The only uncovered surface remains that between the trajectory l and the gain dr of the radius-vector.

Taking into account that:

a) $\frac{dr}{dt} = f`(r.t)$;

b) $dr = f`(r.t)dt$; (2.2-41)

it follows that the sector velocity is

$$\sigma = \frac{dS}{dt} = \frac{1}{2}.r^2.d\theta + \frac{1}{2}.f`(r.t).d\theta = \frac{1}{2}.r.d.\theta\left[r + f`(r.t)dt\right]; \quad (2.2.\text{-}42)$$

Only when the trajectory is in the form of a circumference

$$\frac{dr}{dt} = f`(r.t) = 0 \quad (2.2\text{-}43)$$

that is why only for a circumference the sector velocity is

$$\sigma = \frac{dS}{dt} = \frac{1}{2}.r^2.d\theta = const.; \quad (2.2\text{-}44)$$

For all other curves l the sector velocity is (2.2-42), and (2.2-44) can only be used as a first approximation.

This fact is one of the reasons why the planetary orbits are not closed curves, but rosettes.

2.2.5. General inferences

1. *The nature of the gravitational field is electromagnetic, but it is only a secondary electromagnetic field.*

2. *The gravitational potentials of the bodies (the planets) in Space are always different from Coulomb's potential* ($-\frac{\alpha}{r^2}$).

3. *In addition to the forces of attraction between the bodies, the gravitational fields also generate forces of pressure (stress) upon the bodies from their surface to their axis, which goes through the centers of the interacting bodies. This force influences the tides and the tectonic processes.*

4. *The movement of the planets is only along open orbits (rosettes).*

5. *Strictly speaking, Kepler's laws for the planets are approximate, with a relevant error. A fact which explains the open orbit of Mercury.*

2.2.6. Conclusion

The nature of the gravitational field as a secondary electromagnetic field results into the following:

- **Unity is brought into the picture of the world as an electromagnetic continuum;**
- **Knowledge about the unitary electromagnetic matter of the world is extended.**

Chapter three
Philosophy of the principle of electromagnetic essence of the unitary matter of Nature

3.1. Introduction

The first and most essential starting point for scientific research is the assessment of the essence of the experimental data, described as an empirical regularity (verbally or by formulae), which essence is a scientific fact, which is a point of support for an evidentiary conclusion. *At the same time, it is the initial moment for generating and solving new scientific problems,* **because the genetic scheme of the fact is:** OBSERVATION-MEASUREMENT-INTERPRETATION-FACT. Generally, scientific facts are a direct specific expression of the law for conservation of matter – the tandem of energy and mass. Within which frames we observe reflection of the natural phenomena and carriers of empirical knowledge for the relevant realities, and they are expressed not only by words but by mathematics as well, which, according to G. Galilei is the language of Nature, which are in the form of experimental data, described mathematically as empirical regularities. Here comes the question about he relation between scientific thinking with abstract (idealized) notions (models) and the common sense. This relation is accepted as true only when the scientific claim, as a result of the scientific thinking with relevant causal relations has its experimental validation in Nature, *since the experimental fact as an empirical regularity is also a logical necessity.* In this sense, scientific data (as experimental manifestations) are also models for gnoseological analyses of the processes related to the laws of natural phenomena (realities), for they adequately reflect their essence as part of the whole, of the world, but they also carry, explicitly or implicitly, general features of the whole.

The corollary of the above is that every scientific truth must have a deterministic, direct or indirect empirical basis in its root, for that is exactly why "experiment has an irresistible evidentiary power".

Since ancient times, there exists the idea: a) that all objects in the world (nature) are of the same nature - substance, which is called matter, but it is of various structures and organization; b) that this substance (matter) is constant in quantitative aspect (it cannot be created out of nothing, or destroyed – be turned into nothing); c) that its fragments continuously change in time with regard to: structure, organization, quantity and their manifestations (properties, interactions, processes etc.). Id est this unitary in nature substance alongside with its manifestations, is the resource out of which was formed the unity of nature (the world), and it is accepted and proved that matter itself is a source and a carrier, in the sense of a reason, for its own manifestations.

In the above sense, matter and its manifestations as substance are the initial basis for analysis and synthesis of all physical knowledge, *and thus monism is validated – the material and gnoseological unity of the world* – **the matter and the world are synonyms of one whole – the nature.**

3.2. Proofs for the electromagnetic nature of matter and its manifestations

On the one hand, in physics, there is the idea of a unitary in its essence matter of the world, and on the other, even in its time Maxwell proved the scientific truth (which is accepted in physics) that in its nature matter is also electromagnetic (in its filed and material form). *Hence the conclusion that if the matter in the world is unitary in nature,* **it is solely and only electromagnetic.** *The idea of a matter unitary in its nature excludes any possibilities for a matter of another essence, except of electromagnetic essence.*

3.2.1. Scientific facts in physics which validate that matter is electromagnetic in its nature

1. In physics, there is a section "Electricity and magnetism", or with another name, but always in the sense for which it is accepted, that studies the physical manifestations of electromagnetic field, whose carrier is matter electromagnetic in its nature, i. e. **the electromagnetic field in its essence is electromagnetic matter.**

2. It is accepted (proved) that the atom consists of a nucleus and an electronic envelope, which is of electromagnetic matter. In such a case, there arises the question, what is the nature of matter of the nucleus of the atom. *If its nature is not electromagnetic, the logical conclusion is that it is possible for an interaction to exist between objects of matter with different nature.* But a scientific fact proving such a conclusion does not exist, because of which we have only this conclusion: that matter of the atomic nucleus is electromagnetic, and these interactions are also only of electromagnetic nature, too.

Therefore the atom as a whole, and the molecules together with it have electromagnetic matter as their material resource, or their nature is electromagnetic.

3. It is also known from physics that the forces of interaction (of cohesion) between the atoms and the molecules have electromagnetic nature – they are electromagnetic and are described as derivative of Lennard-Jones potential. Because of this fact it is accepted that the deformations of the material matter, which are called mechanical, and alongside with them the mechanical waves, too, are generally the result of the change of the electromagnetic forces between the atoms and the molecules. *Therefore the nature of the mechanical deformations and mechanical waves is electromagnetic;* i. e. **mechanical waves are material electromagnetic waves, too, such as are deformations.**

4. In the description of the mechanical processes, there is no mention of their essence, and in fact it concerns processes between electromagnetic objects, because the atoms and the molecules of these objects and the forces between them have electromagnetic nature, due to which, in essence, these processes implicitly or explicitly have electromagnetic nature, i. e. they are electromagnetic.

5. In principle, its cause and result are genetically unitary by nature, and, as it is known the electromagnetic field (light, for example) generates a gravitational field (GF

for short). As a result of the electromagnetic field, GF should also have electromagnetic nature, respectively is a specific - secondary manifestation of the electromagnetic field which generates it (EMF for short). *In this respect, the cause (the field that generates GF), should be called primary electromagnetic field, and the one generated by it, secondary electromagnetic field, but for historical reasons it is accepted to be called a gravitational field.* **This way of thought leads to the inderence that there is a primary and a secondary electromagnetic field, which are respectively the cause and the result, known as electromagnetic and GF.**

6. It is known that weak interaction is electromagnetic by nature. By analogy, it should be assumed that strong interaction is electromagnetic as well. The grounds for such a conclusion are that **the name of the nature of interaction between objects is determined not by the form of the formula describing them or the structure of the interacting objects, but by the nature of matter (substance) of the objects which generate this interaction,** id est they are connected into one whole as cause and result. But since the specific conditions and structures of the material objects which are identical by nature can be quite different in the general case, their interactions can have quite different characteristic parameters, features, too, and can have significantly different values of forces.

7. The experimental fact, described by Isaac Newton, by which he unconsciously proved that unitary matter is electromagnetic.

This experimental fact, known as the oldest, the most fundamental and most often observed one, was described by Is. Newton in his book "Optics" in 1704, but physicists are still oblivious about it.

Newton pointed out the availability of the following experimental data described in synthesized form: **"Each body emits and absorbs light", "Bodies turn into light, and light - into bodies" and "The conversion of bodies into light and of light into bodies is a normal natural process".** From these firm verbal empirical regularities and the known electromagnetic law, that nature of light is electromagnetic, **the categorical regularity follows that the nature of matter of bodies is also only electromagnetic,** and ALONG WITH THIS, THAT THE MATTER OF THE WORLD IS UNITARY, TOO, SINCE IT IS ELECTROMAGNETIC. And because it is also the only carrier and generator of all manifestations in the world, **it results from the genetic principle (reason) that the essence of all natural phenomena, of the whole world, is electromagnetic.**

Since this is a universal law, it has a character of a fundamental principle, which is also the initial basis for explorations of matter and its manifestations in nature (the world).

3.2.2. On the reactions in the elementary particles

From the reactions between the elementary particles, out of which are formed the field and the material forms of matter, it is proved unequivocally and categorically that matter has electromagnetic nature. For this proof should only be considered the necessary for this purpose minimum number of known reactions between elementary particles, which prove and illustrate the truth that: **"matter and energy, as a tandem,**

have electromagnetic nature and can convert from one form into another, based on the law for conversion of elementary particles". As a most general definition of the notion (as an idealization), it can be said about the elementary particle that: FIRST - it is always considered as an inseparable whole, and SECOND - it is a special state – a quantum of the field of matter (which, as a field, is the most elementary form of matter), since it is a quantum matter in a field or material form.

It is useful and necessary for the analysis to present (remind) some known and useful for the purpose regularities in the reactions of elementary particles, such as:

1. *There are no basic elementary particles or groups of them that cannot be converted from one kind or form into another in a relevant selection of conditions and order of reactions and with observance of the laws for conservation.* **In this sense, elementary particles are not unchangeable objects.**

2. In conversion of particles, there are always four essential moments:

2.1. *There are parameters, which remain constant,* such as: a) the nature of matter; b) their potential possibility for conversion; c) the sum of their quantities of matter and energy; d) the sum of their electric and baryon charges, of their momentums, etc.

2.2. *There are parameters, which change*, such as: a) the quantities of matter and energy of the individual new particles; b) the structure and organization of the new particles. These parameters basically predetermine their new manifestations (force connections – their force interactions) in the frames of their identical electromagnetic nature.

That is exactly why, after the interactions, new particles are created – results with new manifestations, but within the frames of the initial electromagnetic nature of the initial particles as a reason for new ones to be generated.

2.3. In this sense, the manifestations in interactions (reactions) determine the changes of the properties (parameters) of force interactions of the new particles, while preserving their unitary electromagnetic nature. *We should point out here that certain incorrect statements are sneaking in to claim that some new particles have also a new nature (not electromagnetic), such as the neutron, the proton, etc, but they have no reasons for such claims.* **The reason to reject such flaws, claims, is the fact that during the process of reaction (interaction), no other particles, different by nature, enter the process, but only particles of electromagnetic nature.** Because of this, the new particles are only of electromagnetic nature, since matter cannot be generated out of nothing, not turned into nothing. Therefore, out of electromagnetic initial particles can only be created new particles, which always have the nature of the initial ones.

Examples of reactions, as scientific facts, that the new particles have identical nature to the initial ones are:

1. Between electrons e^-, e^+ and photons γ_1, γ_2

a) $e^- + e^+ \rightarrow \gamma_1 + \gamma_2$; b) $\gamma \rightarrow e^- + e^+$; (3.2-1)

These reactions are experimentally validated scientific facts, according to which the material form of electromagnetic matter in the form of e^-, e^+ can be converted to

a field form in the form of γ_1, γ_2 and vice versa.

2. In the atoms, the electrons e^-, e^+, which are from different atomic orbitals, when absorbing or emitting a photon γ, change their orbital to a higher one or, respectively, to a lower one.

a) $e_1^- + \gamma \to e_2^-$; b) $e_2^- \to e_1^- + \gamma$; (3.2-2)

In the cases: a) the electron e_1^-, absorbing the photon γ increases its kinetic energy by $W_\gamma = h.\nu$ and because of this it moves to a higher orbital - state e_2^-; b) the electron e_2^- emits the photon γ and as a result of this its kinetic energy decreases by W_γ and because of this it moves to a lower orbital - state e_1^-.

3. With sufficiently accelerated electrons e^-, e^+ neutrons $(n, \overline{n})$ and protons $(p, \overline{p})$ are created

a) $e^- + e^+ \to e_0^- + e_0^+ + (n + \overline{n})$;

b) $e^- + e^+ \to e_0^- + e_0^+ + (p + \overline{p})$; (3.2-3)

4. With accelerated protons or a proton plus a photon

a) $p + p \to p_0 + (p + \overline{p})$; b) $p + p \to p_0 + p_0 + (n + \overline{n})$;

c) $p + \gamma \to p_0 + (p + \overline{p})$; (3.2-4)

From the reactions presented so far, an experimental validation of the laws for electromagnetic matter follow, which are:

1. **The nature of elementary particles is only electromagnetic;**

2. **The natures of the atoms and the molecules are only electromagnetic;**

3. **The material and the field form of matter (electromagnetic) can convert from one into another and vice versa; electromagnetic matter can convert into a field form and into a material form of the particles, therefore, the material fragments of nature (the world) can convert from field forms into material forms and vice versa.**

3.2.3. Models of electromagnetic objects with and without an external primary electric field

Let the models for study consist of two sums each with the same number $a = b$ electric charges q_e, with different polarities, but they are equal in value

a) $q_{a_i} > 0$; $q_{b_i} < 0$; b) $|q_{a_i}| = |q_{b_E}|$; (3.2-5)

and their masses are equal in value

$m_{a_i} = m_{b_i} > 0$; (3.2-6)

Let us imagine that from (3.2-5) and (3.2-6) are formed idealized objects, which we shall call ensembles A and B, where $C = A + B$ is the sum of the charges q_{a_i}, q_{b_i}, or $n = a + b$. Let us also assume that the charges q_{a_i} and q_{b_i} are distributed uniformly in a spherical volume V_0 with enveloping surface S_0 and that the electric

charges of different polarity do not annihilate. In these conditions for the relevant ensembles, we can write:

$$\text{a) } A = K_q \sum_1^a q_{a_i} = \sum_1^a m_{a_i} \text{ ; b) } B = K_q \sum_1^b q_{b_i} = \sum_1^b m_{b_i} \text{ ; c) } C = A + B;\ n = a + b; \tag{3.2-7}$$

where:

K_q is a physical constant, which correlates the charge q_e (3.2-5) with its mass m_{e0} (3.2-6). From where we obtain the static systems of equations for the electric $\vec{E}_{a_i}, \vec{E}_{a_i}$ and gravitational fields $\vec{G}_{a_i}$ and $\vec{G}_{b_i}$, in point M at the relevant distance $\vec{r}_i$, from their charges and masses. By taking into account the principle of superposition, for their resultant fields in point M are obtained their relevant values.

$$\text{a) } \vec{E}_C = \vec{E}_{CM} = \sum_1^n \vec{E}_i = \frac{1}{4.\pi.\varepsilon_0} \sum_1^n \frac{q_i.\vec{r}_i}{r_i^3} \geq 0 \text{ ; or}$$

$$\text{b) } \vec{E}_C = \vec{E}_{CM} = \sum_1^n \vec{E}_i = \frac{1}{4.\pi.\varepsilon_0} \sum_1^n \frac{q_i.\vec{r}_i}{r_i^3} \leq 0 \text{ ;} \tag{3.2-8}$$

$$\vec{G}_C = \vec{G}_{CM} = \sum_1^n \vec{G}_i = -\gamma. \sum_1^n \frac{m_i.\vec{r}_i}{r_i^3} = -m_C \frac{\vec{r}_i.\gamma}{r_i^3} < 0 \tag{3.2-9}$$

where: ε_0 is the dielectric constant, γ - the gravitational constant, $n = a + b$ - the number of electric charges in the volume V_0.

Depending on the number a and b of the charges in the ensembles A and B, for the fluxes of the fields, which go outside S_0, valid are the values:

$$\text{a) } C_1 \to A > B \to \Phi_{E_{C1}} = \oint\limits_{(S_0)} \vec{E}_{C1}.d\vec{S} > 0 \text{ ;}$$

$$\text{b) } \Phi_{G_{C1}} = \oint\limits_{(S_0)} \vec{G}_{C1}.d\vec{S} = -m_C.4.\pi.\gamma \text{ ;} \tag{3.2-10}$$

$$\text{a) } C_2 \to A = B \to \Phi_{E_{C2}} = \oint\limits_{(S_0)} \vec{E}_{C2}.d\vec{S} = 0 \text{ ;}$$

$$\text{b) } \Phi_{G_{C2}} = \oint\limits_{(S_0)} \vec{G}_{C2}.d\vec{S} = -m_{C2}.4.\pi.\gamma \text{ ;} \tag{3.2-11}$$

$$\text{a) } C_3 \to APP \to \Phi_{E_{C3}} = \oint\limits_{(S_0)} \vec{E}_{C3}.d\vec{S} < 0 \text{ ;}$$

$$\text{b) } \Phi_{G_{C3}} = \oint\limits_{(S_0)} \vec{G}_{C3}.d\vec{S} = -m_{C3}.4.\pi.\gamma \text{ ;} \tag{3.2-12}$$

It is evident that the ensembles C_1 and C_2 are not with entirely compensated electric fields because the electric charges $a \neq b$, whereas the ensemble C_2 is with entirely compensated electric fields, since its charges of different polarity are the same number $a = b$. Where C_1 and C_2, because $a \neq b$ have external electric fields; and with C_2 because $a = b$ there are no external electric fields and the ensemble – its electromagnetic object C_2 , is called neutral. But all electromagnetic objects

(ensembles) C_1, C_2 and C_3 have external gravitational (secondary electromagnetic) fields and relevant fluxes. In reality, the object C_2 has internal primary electromagnetic fields E_{C2} and only external secondary electromagnetic (gravitational) fields G_{C2}. Owing to this circumstance, it is not externally electromagnetically neutral, but according to contemporary terminology, it is electromagnetically neutral. And indeed, so far there has not been a precise study of the material form of matter, which has not established some structures of electromagnetic fields inside matter.

3.2.3.1. Electrically neutral electromagnetic system (body, object)

Of these three possibilities, the most interesting is the one in the case A = B (eq. 3.2-11).

Here, although the number of the charges in the volume V_0 is the same

$$a = b \neq 0; \qquad (3.2\text{-}13)$$

in random point M outside their enveloping surface S_0 (or the volume V_0), the resultant electric field is zero, or the resultant electric flux through this closed surface is zero, regardless that in its volume V_0 there exist electric charges different from zero.

This fact is defined (determined) as the *effect of total* (maximal) *compensation of electric* (electromagnetic) fields, because for points $M = N$ outside the surface S_0 the electromagnetic fields are zero, i. e. outside the surface S_0 no electromagnetic fields are manifested.

The physical meaning of this phenomenon is the total compensation between electric charges - fields, so that at a certain distance outside them no electromagnetic fields are manifested. The smaller the volume of compensation (with the same number of charges), the more powerful the compensation is, and as a consequence of this is also the result, that the connections between the electric charges are stronger, i. e. the energy of their interaction is greater. Indirectly, this is supported also by the greater density of the charges of different polarity, because of which they are in a smaller volume and the surface S_0 enveloping them is smaller.

In this respect, it follows that with the effect of total compensation in a minimal volume (the case of $A = B$) the force connections should be the greatest between the particles of the ensemble of electric charges (on condition surface S_0 is minimal).

In such an aspect, the conditions of structure of the neutral particles and objects can be sought, but we should take into consideration the circumstance that in a bound state of the compensational effect, the individual charges as elements of the structure of the whole - in force connections, they are not in such a state, as when they are independent, but are in a relevantly restructured form both with regard to their quality and quantity.

The formulations set forth above imply that the more tightly and more uniformly the charges of different polarity are arranged and the smaller the volume of the closed surface, the denser their connecting energy will be (the greater their bounding forces will be) and the denser will be the mass of the ensemble of charges C (at $A = B$), in a minimal volume.

Here we should remind: 1) that a stable system only of central forces cannot be structured and 2) that elementary particles (such as the elementary electric charges) cannot be at rest.

Because of this, as a result of the permanent motion of the charges, they can form stable micro- (nucleons and atoms) as well as macrosystems (bodies).

In these cases of a dynamic state of the system, in addition to outside the surface of the static compensation, there also appear fields of dynamic compensation. These electromagnetic fields oscillate in volume outside the static state of the charges, i. e. outside the surface S_0, respectively the volume V_0. These changing, different from zero (in time and space), electromagnetic fields can be called fluctuating. The reason for this is that the permanently moving charges do not move along trajectories (orbitals) with constant parameters, because of which the electromagnetic fields, which are generated, fluctuate within certain limits as well.

To these fluctuating fields also correspond fluctuating force interactions, which at larger distances are forces of attraction and also are called Van der Waals forces. At short distances between objects, these forces change their sign because of the significant effect of superimposition of these fields.

In this sense is follows that around each material object, at a short distance outside the real limit of its material form of existence, there is a background (halo) of fluctuating electromagnetic field (forces of adhesion, absorption, etc.). If the matter of the object is not homogenous, this halo can be non-uniformly distributed in relation to the surface, and it can increase round denser parts or with larger movements of its structural elements.

This halo is the same electromagnetic field, which is formed round the atoms (the molecules) as a result of their structural elements, which are electrically charged - the nuclei and the electrons in orbitals. **It is exactly these alternating fields that generate the forces of cohesion between the molecules in matter. These fields are manifested on the surface of matter and interact with external electrical charges or substances, including dust particles, which are substance in a very small volume.**

With this formulation of the halo as a field structure, if the halo is notated as electromagnetic field by the symbol $\vec{E}_{\text{c}}$, we can define the forces

A) The force $\vec{E}_{\text{ce}}$, which is generated by the interaction of the field $\vec{E}_{\text{c}}$ with electrical charges q_e (or electron), which generates the diffraction of the electrons - the diffractional force $\vec{F}_{\alpha}$

$$\vec{F}_{\text{ce}} = \vec{F}_{\alpha} = q_e, \vec{E}_c ; \qquad (3.2\text{-}14)$$

i. e. the diffraction of the electron can be not because the electron manifests as a wave, but because the electron is attracted by the substance with electromagnetic force.

b) The force of cohesion $\vec{F}_{\text{c}}$, which is derivative of Lennard-Jones potential, but which is generally generated from the interaction of halo fields $\vec{E}_{\text{c}}$ of the material objects. The interaction between the field $\vec{E}_{\text{ст}}$ of a large body and this of a dust particle, which can be treated as material charge q_n of the halo field $\vec{E}_{\text{c}}$, can formally be notated as force of adhesion

$$\vec{F}_{\text{a}} = \vec{F}_{\text{c}} = q_{\text{n}}.\vec{E}_{c}\,; \qquad (3.2\text{-}15)$$

which attracts and sticks the dust particles to the body.

In this spirit we should say that such a halo of electromagnetic fields (almost stationary or fluctuating) is to be found round all living organisms). Here, in addition to the structure of the whole organism (the body) (due to the flora and fauna), more asymmetries appear in the halo, which persons of extrasensual perception study:

1) on the one hand, due to the different energy fluctuations of the individual parts and organs of the body;

2) due to the different character of metabolic processes in the organism, associated with receipt of nutritional resources (including breathing), their digestion and excretion;

3) due to the different pace of life (metabolism of food) during the annual, monthly and daily rhythms as well as due to the condition of health and other conditions.

In general, the electromagnetic halo of a body (living or not) is a reflection of its internal state.

3.2.3.2. Polar electromagnetic systems (objects, bodies)

In the cases 1) $A > B$ *and* 3) $A < B$ their divergences and fluxes are different from zero, therefore some charges remain uncompensated and, respectively, some electromagnetic fields as well. In this case, it could be assumed that *the compensation is partial*, since the number of the charges of one polarity dominates over the other.

B this case the objects are manifested (interact) as electrical charges, but with a mass larger than the relevant value of their electrical charge, which is the proton and other elementary particles and large bodies.

3.2.3.3. General interpretation

From the presented about the electromagnetic and gravitational fields, it is evident that there is a special case - 2) $A = B$, when outside the surface S_0 of the charges there is no electric flux, but there is always a gravitational one (3.2-11), different from zero.

This is the most common case in nature, since because of the great activity of the electromagnetic fields (electric charges) they are structured into objects, outside which the electromagnetic field is sharply decreasing in one external area, close to the charges. Because of this, at first sight it may seem that there is no electric field (electric charges are in a bound state inside the object), but there is only a gravitational field. In this respect are also the computing methods for gravitational fields. **These established computing methods have formed an incorrect physical idea that the electric charges (respectively electromagnetic fields) and gravitation have almost nothing in common, and thence, that the gravitational field exists independently and irrespectively of the electromagnetic fields which generate it.** *This circumstance has caused and is still causing serious and global damages to science, from the viewpoint of the endeavors to integrate the scientific principles and form unitary principles, for unitary electromagnetic force interactions, and thus have also damaged the idea of electromagnetic matter unitary in its essence. This has been going on in spite of Gustav*

MI's claim (1912), that there is not a single particle of matter, which has no electromagnetic and gravitational properties at the same time.

This serious mistake was due to the circumstance that the computing method (as an abstraction) for the gravitational field is heavily mathematized – physically wrongly - and the gravitational field is ascribed independence as a physical reality, even as a sole physico-genetic basis of the world, as it is in the theory of relativity, without making a profound analysis of the physical factors, on the basis of which it was formed. *This is why, in order to attain unity, and alongside this, a generalization of the idea of matter and its force interactions, it is necessary to unite the electromagnetic and gravitational properties of the electric charges and the asymmetry of their field properties associated with them.*

This is so because in everyday life of real objects, the condition of electric neutrality $C = A + B = 0$ is the most often fulfilled, and when at a sufficient distance from them this condition is always fulfilled, the wrong (eclectic) conclusion is made that the electromagnetic and gravitational fields and respectively their energies exist independently one of another, since it is a known fact that there (in the place), where there is a gravitational field, at a sufficiently long distance from the substance, there is not any electromagnetic field.

Two independent theories contribute to this belief – Maxwell's and Newton-Einstein's. Moreover, because of the great authority of Maxwell's field electrodynamics, all who study the gravitational field, *without whatever physical interpretation (motivation), automatically and wrongly, accept the symmetry in Maxwell's equations as an initial principle for the gravitational field as well.* Furthermore, no independent gravitational waves have been proved experimentally so far, *rot* $\vec{G} \neq 0$ and the quantum gravitation cannot make its first step. *The electromagnetic carriers (generators) of the gravitational field and its asymmetry relative to the electromagnetic field should be accepted as an initial principle, and the compensation effect should be analyzed more profoundly and then will be attained a closer accession to the unity of force interactions and the firm fact of inseparability (experimentally validated) between the electromagnetic and the gravitational fields will be accepted.*

3.2.3.4. Interpretation associated with the effect of compensation of the electromagnetic fields of the electric charges

Based on the effect of compensation of bipolar electromagnetic fields, a structure (object) is formed with partially or completely externally compensated electromagnetic fields.

In complete external compensation, there is a large class of objects, called neutral, in electric respect, or only objects (micro- and macro-), since these which are not explicitly (obligatory) neutral are called charged or polar. Because of this circumstance, since the objects (the neutral ones) externally have only a gravitational field, a wrong (eclectic) conclusion is made that the electromagnetic and gravitational fields of the object are genetically independent.

The neutral objects, in general, are not internally neutral, but contain bound bipolar charges, which are in constant motion, and are a source of electromagnetic

fields, alternating in time, inside and in a part of the external volume of the object. Therefore, the neutrality of the object is only an external indicator of internal diversity of bound polar fields in permanent motion; it does not mean lack of charges in a given material object as a whole.

As a result of the formation of a new object, which on average in time is fully neutral electrically, externally and close to its surface, and contains in its inside permanently moving - fluctuating – elements of different polarity (in a bound state), which generate external fluctuating electromagnetic field Φ, which sharply decreases with the distance ($\Phi = f\left(\frac{k}{r^n}\right)$, $n > 3$) and is characterized by the following features:

1) The neutrality is manifested in a place (point) at a certain distance over the enveloping surface of the permanently moving charges (where the resultant field is annulled) and in the volume outside this surface, determined by the aggregate of these places (points).

2) The aggregate of these points determines the surface of neutrality (or the neutral surface) as a limit of the volume, outside which the object is neutral. Here it should be noted that we consider some minimal value of the field halo, after which it is assumed that it does not have a practical value.

3) The space between the surface enveloping the charges and the neutral one is occupied by a layer of a resultant electromagnetic field of charges, different from zero, which filed we call halo.

4) The real dimension of this halo has a dynamically changeable dimension (thickness), since the elements (the charges), which generate it, are in a dynamic state, too.

5) For general reasons, the dimension of the halo (at sufficient density of the charges) is to be relatively small in comparison with the linear dimension (diameter) of the neutral object.

6) By means of this field halo, as a resultant electromagnetic field, the neutral object is to be able to interact with the electromagnetic forces of another neutral object, if their field haloes touch or penetrate each other.

In other words, *two objects (or microobjects) neutral in electric respect can interact with each other by fluctuating electromagnetic forces.* These forces are known and are called fluctuating or forces of Van der Waals, forces of adhesion, etc.

7) Item 6 implies that there are electromagnetic forces between neutral objects (particles), too, but by character, depending on the distance, they have different exponents – as per Lennard-Jones potential.

8) The neutral objects may have stable dynamic structure (for example neutron, atom, molecule, etc.).

Because the electromagnetic fields are screened and the fluctuating forces in the neutral microobjects are short-acting, it follows that the number of the elements in the associates should have an upper limit in view of their stability (those ones which are formed from the neutral microobjects through the fluctuating forces).

9) Emission or accumulation of additional (a small number of) charges implies that the neutral objects should retain their fundamental properties (interactions), and upon them should also be imposed the properties of the polar objects. But in this case

the additional charges, forming the polarity of the object, should be in a bound state as elements of the general structure of the object.

10) It is characteristic of the neutral objects that the volume in which the electromagnetic fields are compensated is infinitely small in relation to the volume in which are manifested only its gravitational fields. This is one of the reasons to arrive at the absurd, that the two kinds of fields are independent.

3.2.4. Quantizing of the gravitational masses and energies

3.2.4.1. Basic assumptions

Starting from the fact that the generator and carrier of the gravitational masses and energies are the quantized, bipolar independent electrical charges in the form of an electron and a positron with values $q_e = \mp 1{,}6.10^{-19} C$ and that they are quantized masses m_{e0} and the energy $W_{e0} = m_{e0}.c^2$. and that the relation of these quantities to their relevant gravitational mass m_{eG} and energy W_{eG} according to (1.4-5) is

$$k_{eG} = \frac{m_{e0}}{m_{eG}} = \frac{W_{e0}}{W_{eG}} \approx 4{,}17.10^{42}, \qquad (3.2\text{-}15)$$

which can be further specified, but k_{eG} is always constant and expresses the relation of the electromagnetic quantities to the corresponding gravitational ones.

On this condition, the conclusion follows that the gravitational mass m_{eG} and energy W_{eG} are quantized as well, and their values can be computed through k_{eG} as follows:

a) The smallest quantum of the gravitational mass of the electron is

$$m_{eG} = k_{eG}.m_{e0} = 4{,}17.10^{-42}.9{,}1.10^{-31} = 3{,}79.10^{-72} kg ; \qquad (3.2\text{-}17)$$

b) The smallest quantum of the gravitational energy of the electron is

$$W_{eG} = k_{eG}.W_{e0} = k_{eG}.m_{e0}.c^2 = 4{,}17.10^{-42}.9{,}1.10^{16} = 3{,}41.10^{-65} J ; \qquad (3.2\text{-}18)$$

In this sense, the mass and energy of the electron at rest are

a) $m_e = m_{e0} + m_{eG} = 9{,}1.10^{-31} + 3{,}79.10^{-72} kg$;

b) $W_e = W_{e0} + W_{eG} = 8.19.10^{-14} + 3{,}41.10^{-65} J$; (3.2-19)

3.2.4.2. The gravitational mass m_f and energy of the photon are at the value of

$$h_G = \frac{h}{k_{eG}} = \frac{6.c^2.10^{-34}}{4.17.10^{42}} = 1.58.10^{-76} ; \qquad (3.2\text{-}20)$$

which value can be called Planck's graviphoton constant. The gravitational mass m_f and energy W_{fG} of the photon are

a) $m_{fG} = \frac{h_G.\nu}{c^2} = \frac{1{,}58.10^{-76}}{9.10^{16}}.\nu = 1{,}76.10^{-59}.\nu.kg$;

b) $W_{fG} = h_G.\nu = 1{,}58.10^{-76}.\nu\ J$; (3.2-21)

In this sense, the gravitational mass and energy of the photon are quantized quantities as well.

3.2.5. Probabilities of material systems formation

a) ***On the probability of formation of structural systems of micro- and macroobjects - bodies of the two kinds of field.***

This probability P is also determined with respect to the relations of the magnitude of the force interactions (the forces $F_e < 0$ and $F_G < 0$) of attraction between the electromagnetic and gravitational fields, and with the microobjects

$$\text{a) } P_{eT} \sim \frac{F_e}{F_e + F_G} = \frac{10^{40}}{10^{40}+1} \approx 1;$$

$$\text{b) } P_{GT} \sim \frac{F_G}{F_G + F_e} = \frac{1}{10^{40}+1} \approx 10^{-40} \approx 0; \qquad (3.2\text{-}22)$$

Therefore, the probability of formation of electromagnetic systems-bodies is 10^{40} times greater than this of the gravitational systems (based on the gravitational forces).

This means that all micro- and macroobjects-bodies in the universe (but not the planetary systems and the system of the universe), as individual objects-bodies, are formed by their electromagnetic forces.

b) ***On the formation of cosmic systems - the structure of Universe as a system of planetary bodies (objects) here is*:**

1) *as a result of the effect of compensation, which was considered in detail in the previous paragraphs, the electromagnetic fields outside the volumes of the objects formed by them are almost annulled.*

2) *because of the cumulative effect and the large masses of the planetary objects, the gravitational forces have are of crucial importance with them, because of which the cosmic systems are formed by the gravitational forces; therefore, the probability at* $F_{ek} \approx 0$

$$\text{a) } P_{GK} \sim \frac{F_G}{F_{ek} + F_G} \approx 1; \text{ b) } P_{ek} \sim \frac{F_{ek}}{F_{ek} + F_G} \approx 0; \qquad (3.2\text{-}23)$$

Note: Because when analyzing the cosmic systems, in some cases gravitational forces are available for which, in the vicinity, there are no material objects to be found, instead of assuming the availability of hidden masses - dark body, which generates them, it is possible to assume that there are non-compensated electromagnetic forces of near objects, which add to the gravitational forces and determine the relevant resultant forces.

Thus, in the cosmic interactions it can be assumed that some non-compensated electric forces $F_{ek} < 0$, take part, too, in which the probabilities of cosmic systems formation are

$$\text{a) } P_{ek} \sim \frac{F_{ek}}{F_{ek} + F_G} \to << P_{Gk}; \text{ b) } P_{Gk} \sim \frac{F_G}{F_{ek} + F_G} \to 1; \qquad (3.2\text{-}24)$$

3.2.6. Inferences to chapter three

1. Nature is a unitary material continuum of electromagnetic essence (nature), whose matter is in a material and field (electric, magnetic and gravitational fields) form.

In this sense, the natural objects are genetically homogenous, have a relatively independence, with regard to the quantity and structure of their matter, and are connected one to another by a homogenous structural force connections, due to which they are also structural elements of the whole, called nature (world, universe).

2. The material natural objects (structural elements) can be restructured (converted) from material into field forms and vice versa, in different structural and quantitative states. It is exactly these different states that render to the objects of electromagnetic matter different specific properties and relative independence relative to the whole – the nature.

3. The unitary electromagnetic matter of the natural objects, which have relative independence and respectively specific properties, is also the unitary subject for study (research) of the nature as one whole. In this sense, the science, which studies the whole nature should be called naturology.

And the sciences about the individual natural objects or properties are components of the science of naturology and are called particular or specific sciences. I. e. the science of naturology is a system of specific sciences.

In this sense all sciences are characterized by a) unitary theoretical basis (logical fundament), which reflects the principles (laws) common for all sciences - naturology and specific sciences. This part of the theoretical fundaments is called here principle part and it is given in a mathematical model by eq. (P-13).

The principal is the groundwork (the root) of the theoretical fundament of all specific sciences, i. e. it is the main part (the hat), but in practice, except when it is cited with the science of naturology and the inferences from the basic laws of the dynamics of the naturology, what is the section electrodynamics in physics, the principal is almost never cited, because it is understood implicitly by itself.

b) The specific sciences bring in additional principles (formulations, laws) to the principal, which reflect their specific regularities, which limit the range of research only within the frames of the specific science, since the principal is all-comprehensive – it reflects the whole natural diversity.

4. The unitary electromagnetic matter, which is a conceptual notion, and the real and natural notions through which it demonstrates its real availability are the notions of energy W and of mass m, which as a consequence of the law for conservation of the energy and mass, which are products of the electromagnetic matter and are interdependent through the laws

$$\text{a) } W = m.c^2 \text{ ; b) } W = \left(m_0^2.c^4 + p^2.c^2\right)^{1/2}; \qquad (3.2\text{-}25)$$

and:

a) on condition that for the velocities v_i of the objects it holds true

$$\text{a) } v << c \text{ ; b) } \frac{v}{c} \to 0; \qquad (3.2\text{-}27)$$

the laws for their energies are simplified. These are the laws of mechanics of electromagnetic objects - the laws of Newton, which form the section of mechanics in physics. *This section has been developed without touching the issue of the essence of matter of objects or the essence of energy, except in cases, when issues connected*

with gravitation are treated; then the word goes about gravitational fields, forces and energies.

c) treating the energy of electromagnetic waves in the form of photons with energy W_r, mass m_f and pulse $\vec{P}_\mathrm{F}$ and force $\vec{F}_\mathrm{f}$ (pressure)

$$\text{a) } W_\mathrm{f} = h.\nu \text{ ; b) } m_\mathrm{f} = {W_\mathrm{f}}/{c^2} \text{ ; c) } \vec{P}_\mathrm{f} = \frac{W_f}{c}.\vec{c}_0 \text{ ; d) } \vec{F}_\mathrm{f} = \frac{\vec{P}_\mathrm{f}}{\tau_\mathrm{f}} \text{ ; e) } p_\mathrm{f} = \vec{F}_\mathrm{f}.\tau_\mathrm{f} \text{ ;} \qquad (3.2\text{-}27)$$

Depending on the frequency ν of the photons, their electromagnetic energy at frequency up to 10^{12} Hz forms a photon gas whose energy is categorized as thermal, irrespective of the fact that electromagnetic energy of photons with frequency higher than 10^{12} Hz can also be converted into thermal energy, since every structure of the electromagnetic energy can, on suitable conditions, become restructured, for example into mechanical, chemical, biological, thermal, etc.

5. Depending on the state of compensation of the bipolar electrical charges in a stable system-object, objects are categorized as follows:

5.1. Neutral, with complete compensation of the electromagnetic fields - outside the object, there is:

a) at a very near distance, only a halo of alternating magnetic fields – continuation of the forces of cohesion, which are determined as derivatives of Lennard-Jones potential.

b) Gravitational fields, which are unipolar.

5.2. Polar with partially non-compensated electrical charges, and because of this, outside the object, there is:

a) at long distances as well, electromagnetic fields, as a uni- and bipolar (dipole) object.

b) Gravitational fields, which are unipolar

5.3. *It is seen from point 5.1. and 5.2 that it is not possible for a gravitational field to exist independently without a generator and a carrier in the form of electromagnetic matter. I. e. the gravitational field is inseparable from its electromagnetic carrier.*

6. The diffraction of the electrons round material objects is due to the fact that the electrons move from the objects as a consequence of the halo round them from its alternating electromagnetic field, which generates the forces of cohesion, and not due to a property of the electron to act as a wave.

7. The adhesive forces are a result of the last halo round the material objects, which in essence generates forces of cohesion, which are sharply decreasing with the distance, because they are derivatives of Lennard-Jones potential.

8. Gravitational fields, masses, energies of the electrons are quantized, as are their electromagnetic quantities.

Chapter four
Thermal electromagnetic phenomena – the physical basis of thermodynamic processes

4.1. Model of the thermal energy and its processes

4.1.1. Mechanical analogy[4]

At first, we interpret the interaction as a central collision between two spherical bodies - one and two, which have the same masses at rest.

$$m_{01} = m_{02} = m_0 = const.; \tag{4.1-1}$$

Body one moves at velocity v_i related to body two, which is at rest ($v_2 = 0$) and has momentum $\vec{P}_i$ and kinetic energy W_{k1}

$$\text{a) } \vec{P}_1 = m_0.\vec{v}_1 \text{ ; b) } W_{k1} = \frac{m_0.v_1^2}{2}; \tag{4.1-2}$$

The duration of the collision is τ seconds along the distance

$$\Delta r = \frac{a_1.\tau^2}{2} = \frac{v_1.\tau}{2}; \tag{4.1-3}$$

where:

$$\vec{a}_1 = \vec{v}/\tau = \frac{\vec{F}}{m_0}; \tag{4.1-4}$$

is the mean value of the negative acceleration, which determines the counteracting force

$$\vec{F}_2 = \vec{F}_{a1} = m_0.\vec{a}_1 = \frac{m_0.\vec{v}_e}{\tau}; \tag{4.1-5}$$

on the part of body two and the cessation of the motion of body one from velocity v_i to zero, as a result of which kinetic energy W_{k1} of body one is expended, i. e. from

$$\text{a) } W_{k1} = \frac{m_0.v_i^2}{2}; \rightarrow \text{b) } W'_{k1} = 0 \tag{4.1-6}$$

Along with that, body two is set in motion from velocity zero ($v_2 = 0$), ignoring the losses, to velocity v_2 and kinetic velocity W_{k2}

$$\text{a) } v_2 = v_1; \text{ b) } W_{k2} = W_{k1} = \frac{m_0.v_2^2}{2} = \frac{m_0.v_1^2}{2}; \tag{4.1-7}$$

Mechanics does not clarify the mechanism of this process of transfer of W_{k1} from body one to body two (4.1-7). It is generally spoken about deformations, but how exactly this kinetic energy is transported is not explained and the answer is delicately avoided.

---

[4] These introductory paragraphs are included since experts in thermodynamics are not always sufficiently informed about the issues of electrodynamics.

4.1.2. On the mechanism of transportation of the kinetic energy from one to another body

First of all, there is the question what the essence (nature) of the kinetic energy as a physical object (phenomenon) is, which is apparently (clearly) something material. *Because it cannot be argued that it is conserved, if it is not a material physical quantity and if it is not homogenous, but manifesting in various structural states.*

This question is answered, for example, by using the model of the independent negative electric charge with a value $q_e = 1{,}6.10^{-19} C$ (Coulombs), which is also an elementary particle of matter, called electron.

When set in motion by an external force, the electron, which has mass at rest

$$m_{e0} = \frac{q_e^2}{4\pi\varepsilon_0 r_{e0} . c^2} = q_e^2 . k_e : k_e = \left(4\pi\varepsilon_0 . r_{e0} . c^2\right)^{-1}; \qquad (4.1\text{-}8)$$

where: ε_0 is the dielectric constant of vacuum; r_{e0} – the classical radius of the electron; c – the velocity of electromagnetic waves (light) in vacuum.

When the electron is set in motion at velocity $v << c$, a magnetic field is generated around it of intensity

$$\text{a) } \vec{H} = \varepsilon_0 . \left[\vec{v} . \vec{E}\right]; \text{ b) } \vec{E} = \frac{q_e}{4\pi\varepsilon_0 . r^2} . \vec{r}_0 ; \ \vec{r}_0 = \frac{\vec{r}_0}{\left|\vec{r}_0\right|}; \qquad (4.1\text{-}9)$$

The magnetic energy of the electron at velocity $v << c$ is

$$W_{e\mu} = \frac{m_{e0} . v^2}{2} = W_{ek} = \frac{m_{e0} . v^2}{2}; \qquad (4.1\text{-}10)$$

where: $\vec{E}$ is the intensity of the electric field of the electron.

Id est not only by value, but also by essence (nature) the kinetic energy of the electron is identical (equivalent) to its magnetic energy, since it was passed to it from the outside through electromagnetic force $\vec{F}_e = q_e . \vec{E}_B$, to which corresponds the elementary energy $dW = \vec{F}_e . d\vec{r}$ and through integration

$$W_e = \int_0^{\Delta r} \vec{F}_e . d\vec{r} = \frac{m_{e0} v^2}{2} = W_{e\mu} = W_{ek}; \qquad (4.1\text{-}11)$$

where: Δr is from (4.1-3); $\vec{E}_B$ - external electric field .

In this way through the equation (4.1-11), since according to the law for conservation of energy it is impossible through force F_e both energies $W_{e\mu}$ and W_{ek} to be passed at the same time, but only one of them, the electromagnetic energy $W_{e\mu}$ is passed. To clarify the physical sense of the notion of force F follows from its dimensionality

$$\text{Force } F \text{ has dimensionality} \rightarrow \left[N\right] = \frac{Joule}{meter} = \frac{\left[J\right]}{\left[m\right]}; \qquad (4.1\text{-}12)$$

Hence the force is the energy [*J*] exchanged along a unit of distance $\left[m^{-1}\right]$ in the process of interaction between the two bodies (electrons).

In the above physical sense of the notion force in the interaction (collision) of the

two the electrons, which are counterparts to the two spherical bodies, the magnetic energy of electron one, as a result of the mean acceleration a, (4.1-4) electromagnetic waves are emitted, according to the laws of electrodynamics with power *N* of the electromagnetic waves

$$\mathrm{N} = \mathrm{K} \,.\, a^2 \,; \qquad (4.1\text{-}13)$$

where: *K* is a physical constant.

By this mean power *N* for time τ of the interaction and with the available acceleration (4.1-4) magnetic (kinetic) energy $W_{e\mu} = W_{k1}$ is transferred from electron one to electron two, acting upon it by momentum $d\vec{P} = \vec{F}_p dt$, respectively acting upon electron two by force $\vec{F}_p = d\vec{P}/dt$ and accelerates it to velocity $v_2 = v_1$, i. e. imparts kinetic energy W_{kl} to it. Or the energy received by electron (body) two for time τ is

$$W_{k2} = W_{k1} = N.\tau = \frac{k.v_i^2}{\tau} = \frac{m_0.v_i^2}{2} \,; \qquad (4.1\text{-}14)$$

Here body (electron) two with mass m_0 counteracts with its inert force

$$\vec{F}_i = \frac{dW_k.\vec{r}_0}{\mathrm{dr}} = \frac{d\vec{P}}{dt} = -m_0.\frac{dv_1}{\mathrm{dt}} = -m_0.\vec{a}_1 \,; \qquad (4.1\text{-}15)$$

This is the mechanism of interaction, in which the electromagnetic (kinetic) energy acts on the active object, which in this example is body (electron) one, transforms, during the interaction, the magnetic (kinetic) energy $W_{e\mu}$ *localized to it in the form of electromagnetic waves, as a result of the acceleration, which waves transport the energy to body (electron) two and the energy acts upon the body with its momentum* $\vec{P}_{e\mu}$ *respectively with the force* $\vec{F}_p$ *for time* τ

$$\text{a) } \vec{P}_{e\mu} = \frac{W_{e\mu}}{\mathrm{c}}\vec{c}_0 \,; \text{ b) } \vec{F}_p = \frac{d\vec{P}_{e\mu}}{\mathrm{dt}} \approx \frac{\vec{P}_{e\mu}}{\tau} \,; \qquad (4.1\text{-}16)$$

imparting to it acceleration $\vec{a}_2$, velocity v_2 and kinetic energy $W_{k2} = W_{k1} = W_{e\mu}$, i. e.

$$\text{a) } \vec{a}_2 = \vec{F}_p/\mathrm{m}_0 \,; \text{ b) } \vec{v}_2 = \frac{\vec{a}_2\tau^2}{2} \,; \text{ c) } W_{k2} = W_{k1} = W_{e\mu} = \frac{m_0.v_2^2}{2} = \frac{m_0.v_i^2}{2} \,; \qquad (4.1\text{-}17)$$

Since the energy has only electromagnetic essence and the masses have only electromagnetic essence, the mechanism of force interaction described above hold true for all processes of force action, with respective specificities depending on the situations, for the form of the mass and for the dependence of the force $\vec{F}_p$ as a function of time.

The other significant specificity is in the structure of the electromagnetic waves, called photons. Photons are the elementary particles out of which are made the electromagnetic waves emitted by the substances of the bodies. The electromagnetic waves, typical of the carriers of thermal energy are with frequency up to about 12^{12} Hz, and their photons are with length, determined by time $\tau \approx 10^{-8} s$ of the emission or absorption of the bodies and the velocity of the electromagnetic waves (the light)

$c = 3.10^8\ m/s$. Hence their length l_v is about

$$l_\nu \approx c.\tau = 3.10^8.10^{-8} \approx 3m; \quad (4.1\text{-}18)$$

The maximal dimension of the cross-section of the photons with

$$D \approx 10^{-7} \quad (4.1\text{-}19)$$

These data are for their effective values, which are used in the computations. In reality, the lengths are longer, but with heavily decreasing power.

The action of the photons is illustrated by the following examples:

First. The power of the electromagnetic waves - a flux of photons according to Stefan-Boltzmann law

$$\Pi = \sigma.T^4 = w.\vec{c} = h\sum \nu_{\mathrm{i}}.c;\ w = h.\sum \nu; \quad (4.1\text{-}20)$$

where: σ - Stefan-Boltzmann's constant; T - temperature; $w = h\sum \nu_{\mathrm{i}}$ - density of the energy of the photons; h – Planck's constant; ν_{i} - the frequency

Photons are characterized by energy W_f, mass m_f, momentum $\vec{P}_f$ and force $\vec{F}_{\mathrm{f}}$, as follows

a) $W_{\mathrm{f}} = h.\nu$; b) $m_{\mathrm{f}} = W_{\mathrm{f}}/c^2$; c) $\vec{P}_{\mathrm{f}} = W_{\mathrm{f}}/c.\vec{c}_0$;

d) $$\vec{F}_{\mathrm{f}} \approx \frac{P_{\mathrm{f}}}{\tau} = \frac{W_{\mathrm{f}}}{c.\tau}:\vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}; \quad (4.1\text{-}21)$$

upon a unit of surface, which, when reduced for surface *S,* are

a) $\vec{P}_{\mathrm{S}} = \vec{P}_{\mathrm{n}}.S = S.\sum \vec{P}_{\mathrm{f}}$; b) $$\vec{F}_{\mathrm{S}} = \vec{F}_{\mathrm{n}}.S = \frac{d\vec{P}_{\mathrm{S}}}{dt} = \frac{\vec{n}.S}{c}; \quad (4.1\text{-}22)$$

That is why when the electromagnetic waves (photons) land upon an object (body) with mass m_0 they impart to it acceleration $\vec{a}_{\mathrm{i}}$, velocity $\vec{v}_2$ and kinetic energy according to (4.1-17).

Second. The laser beam is a flux of photons with a great density of energy w_{L}, and a cross-section of the order of $D \approx 10^{-6} m$.

This beam also generates pressure $\vec{P}_L$, force $\vec{F}_{\mathrm{L}}$ and energy W_L.

Evidently, the two significant features of the electromagnetic waves are:

a) *They are carriers of the energy, which is absorbed and converted into kinetic (magnetic) energy of the object (body) which has absorbed it. As a result of this, the dynamic state and the structure of the object may be changed.*

b) *They have momentum, generate pressure and force upon the object that has absorbed them with the respective consequences.*

4.1.3. Characteristic features of thermal energy

For the historical development of knowledge about thermal energy, in still unconscious form, it can be emphasized on

1. Isaac Newton, in his book "Optics…" of 1704, stated in a synthesized form:

"All bodies emit and absorb light."

"The bodies convert into light, and the light into bodies."

"These are normal natural phenomena."

2. G. Kirchhoff in 1860 proved the law which stated:

"All bodies emit W_i and absorb W_k energies of radiations whose relation

$$W_i \Big/ W_k = f(\nu T); \qquad (4.1\text{-}23)$$

does not depend on the kind of substance, but only on the frequency ν of the temperature T in K.

3. Max Planck, in 1900, gave the law of the energy of the photon in the form

$$W_f = h.\nu; \qquad (4.1\text{-}24)$$

where: h is Planck's constant, ν - the frequency.

He also proved (see paragraph 2.1.22) that all atoms (molecules) incessantly at short intervals of time emit and absorb photons. And the photons have

$$\text{a) } W_f = h.\nu \text{; b) } m_f = W_f \Big/ c^2 \text{; c) } \vec{P}_f = W_f \Big/ c \,.\vec{c}_0 \text{; d) } \vec{F}_f \approx \frac{\vec{P}_f}{\Delta t} = \frac{d\vec{P}_t}{dt}; \quad (4.1\text{-}25)$$

which are emitted and absorbed from different directions, and with different energies (momentums). And for a unit of time the sum of the forces $\vec{F}_0$ of the recoil in the emission and $\vec{F}_н$ of the pressure in the absorption of the photons is different from zero

$$F_f = \sum \vec{F}_0 + \sum \vec{F}_н \neq 0, \qquad (4.1\text{-}25a)$$

because of which they impart accelerations $\vec{a}$ and velocities to the atoms (molecules) with mass m_0 and set them into permanent oscillating motion on condition that the temperature is $T > 0K$, and this condition is always available in the visible world.

The fact that all material objects consist of atoms and molecules and continuously emit photons into the environment implies that there are photons in this environment, which form a photon gas with density of the energy $w_f > 0$.

That is why in nature there is no place without a photon gas, i.e. in the environment as well as between the atoms and the molecules of the substance, there is always photon gas.

This gas causes the independent electrons to oscillate – "Lebolski" aberration. And it is not from virtual, but because of real photons, which are constantly absorbed and emitted by the electrons in their interaction with the photon gas.

It is exactly this photon gas that interacts with the substance - it absorbs photons from the photon gas. In this respect, the energy described by Stefan-Boltzmann law and the laser beam are relevant structures of photons - photon gas.

And the temperature T_0 of the environment is proportional to the density of the energy w_t of the photon gas, i. e.

$$T_0 \equiv w_f; \qquad (4.1\text{-}26)$$

These oscillating motions of the molecules of the substance loosen its structural bonds. That is why at higher temperature, since there is a larger density of the energy (according to 4.1-26) of the photons (of the photon gas), and thence also a larger

loosening of the structural bonds, and with the increase of w_t *, the loosening of the bonds of the solid body increases too, and it turns into liquid. And at even larger* w_t *the substance turns into gas, where the structual bonds of the molecules are almost annulled and the aggregate state of matter changes.* In this sense, the question is answered

4. *What is thermal energy?*

Thermal energy is kinetic energy in the form of photon gas, which is always available at T > 0K, and this condition is always fulfilled in the visible world, because of which there is always photon gas in the environment, respectively thermal energy.

Or there is no place in nature, where there is no thermal energy and there is no substance in nature, whose molecules are not in oscillating (moving) state.

These two natural phenomena should make the basis of the science of thermal processes and phenomena since thermal energy is the energy of the photon gas, which is a natural fact. This is the answer to the fundamental question of thermodynamics from a summarised physical point of view about the essence of the energy as a material quantity, which is eternal and is eternally restructured from one into another state.

4.1.4. The reason of Clapeyron's law is the energy of the photon gas

4.1.4.1. The temperature is proportional to the density of the thermal energy

A. Initial assumptions

A.1. *The gaseous particles (molecules) moving at velocity v constantly emit and absorb photons and are in a medium of photon gas.* Let in a unit of volume of the gas there are n_0 molecules (the concentration of the molecules is n_0), and the densities of the energy and mass of the photon gas are w_f and ρ_f ($w_f = \rho_f.c^2$). As a result of the forces (momentums) of recoil, which they receive from the momentums $\vec{P}_f = {}^{W_f}\!/_{c}\,.\vec{c}_0$ they move at velocity v_i and receive kinetic energies W_{kmi} at velocities $\bar{v}^2$. The mean statistical square of the velocity $\bar{v}^2$ determines the average kinetic energies of the molecule W_{km} and of the density of the energy of the gas w_{kt}, as follows, at mass m of the molecules

$$\text{a) } W_{km} = \frac{m.\bar{v}^2}{2} = kБ.T = \frac{w_f}{n_0}\text{; b) } w_{KT} = n_0.W_{kn} = n_0.k_Б.T = w_f\text{;} \tag{4.1-27}$$

The pressure of the photon gas is

$$p_f = \frac{1}{3}w_f = \frac{1}{3}w_{kT} = \frac{1}{3}n_0.k_Б.T\text{;} \tag{4.1-28}$$

In an elastic collision of the molecule it generates pressure

$$p_{\Gamma} = \frac{2}{3} w_{\text{КТ}} = \frac{2}{3} w_{\text{f}} = \frac{2}{3} n_0 . k_{\text{Б}} . T \; ; \qquad (4.1\text{-}29)$$

where КБ is Boltzmann's constant.

2. *because of the high velocity "c" of the photons, their distribution in a finite volume is always uniform, since their time of relaxation is practically* $\tau < 10^{-6} s$.

3. The collisions between the molecules are about 10^{10} in a second and it is accepted that they are fully elastic.

4. From (4.1-27) and (4.1-28) the temperature is derived

$$\text{a) } T = \frac{W_{\text{КМ}}}{\text{k}_{\text{Б}}} \; ; \text{ b) } T = w_{\text{КТ}} . \frac{1}{n_0 . k_{\text{Б}}} \; ; \qquad (4.1\text{-}30)$$

$$T = \frac{w_{\text{КТ}}}{n_0 . k_{\text{Б}}} \; ; \qquad (4.1\text{-}31)$$

From (4.1-30) and (4.1-31) it is evident that the temperature is proportional to the density of the thermal energy. And in electrodynamics, according to Maxwell's law on pressure the energy W_T and mass m $\left(W_{\Gamma} = m_{\Gamma} . c^2\right)$ move from places of a larger density of the energy - w and of the mass $\rho_{\text{m}} = \frac{w}{e^2}$ toward the places of smaller w and ρ_{m}. From here, according to the laws of electrodynamics, the thermal energies W_T and mass m_T also move from places of higher temperatures to places of lower temperatures. **This is the second principle of the theory of thermal phenomena.**

4.1.4.2. On Clapeyron's law

In a closed vessel of volume $V_0 = l_0^3$ the density of the energy when the volume and the pressures are changed and in balanced states at constant quantity of the thermal energy is

$$W_{\Gamma} = W_{\text{f}} . V_0 = const. = K \; ; \qquad (4.1\text{-}32)$$

hence

$$p_1 . V_1 = p_2 . V_2 = \frac{2}{3} w_{\text{f}} . V_0 = const. = K \; ; \qquad (4.1\text{-}33)$$

Proceeding from Stefan-Boltzmann law or from (4.1-27), the result is that

$$w_{\Gamma} = w_{\text{f}} = \frac{\sigma . T^4}{c} = k_{\text{c}} . T = n_0 . k_{\text{Б}} . T \; ; \; k_{\text{c}} = \sigma / c \; ; \qquad (4.1\text{-}34)$$

and also that the constant *K* depends on the temperature

$$W_{\Gamma} = w_{\text{f}} . V_0 = k_{\text{c}} . T . V_0 = n_0 . k_{\text{Б}} . T . V_0 = K . T \; ; \text{ b) } K = k_{\text{c}} . V_0 . T = n_0 . k_{\text{Б}} . V_0 . T \; ; (4.1\text{-}35)$$

The reason of Clapeyron's law is in the fact that at certain temperature and adiabatic process (conservation of thermal energy) in ideal gas, the product of the pressure by the volume of the gas is proportional to the temperature (density of the

energy of the photon gas).

4.2. Generating thermal energy

4.2.1. General assumptions

4.2.1.1. Max Planck in 1900 proved that the atoms (molecules) constantly at short intervals of time, emit and absorb electromagnetic energy in the form of short-lasting momentums (of the order of $\Delta t = \tau \equiv 10^{-8} S$) of electromagnetic energy of electromagnetic waves, which are called photons. The photons have energy W_{fi}, mass m_{fi}, momentum $\vec{P}_{\text{fi}}$ and force $\vec{F}_f$, i. e.

a) $W_{\text{fi}} = h.\nu_{\text{i}}$; b) $m_{\text{fi}} = W_{\text{fi}} / r^2$; c) $\vec{P}_{\text{fi}} = m_{\text{fi}}.\vec{c} = W_{\text{fi}} / c \,.\vec{c}_0$;

d) $\vec{F}_{\text{fi}} = \dfrac{d\vec{P}_{\text{fi}}}{dt} = \dfrac{dW_{\text{fi}}}{dr}.\vec{c}_0$; $\vec{c}_0 = \dfrac{\vec{c}}{|\vec{c}|}$; (4.2-1)

A surface of a substance (body) with an area $S = 1$ for a unit of time $t = 1$ according to Stefan-Boltzmann law (1879-1984) emits power N of electromagnetic energy of ensemble (gas) photons and generates pressure $\vec{p}_{\text{п}}$ and force $\vec{F}_n$ as follows

a) $\vec{N} = \dfrac{dW}{dt}.\vec{c}_0 = \vec{\Pi} = \sigma.T^4.\vec{c}_0 = \omega_{\text{п}}.\vec{c} = \left[\vec{E}.\vec{H}\right]$; b) $\vec{p}_{\text{п}} = \dfrac{\vec{\Pi}}{c} = w_{\text{п}}.\vec{c}_0$;

c) $\vec{F}_{\text{п}} = \dfrac{dW_{\text{п}}}{dr}.\vec{c}_0.\dfrac{d\vec{\Pi}}{c.dt} = \dfrac{d\vec{\Pi}}{dr}$; d) $d\vec{r} = \vec{c}.dt$; (4.2-2)

This dependence $\vec{\Pi} = \left[\vec{E}.\vec{H}\right]$ in electrodynamics is called a vector of pointing, and $\vec{E}$ and $\vec{H}$ respectively, are the intensities of the electric and the magnetic fields.

If this force (or pressure $\vec{p} = \dfrac{\vec{F}}{S}$) land; A. Upon a surface of a body of area $S \neq 1$, upon the body acts force $\vec{F}_{\text{S}} = \vec{F}_{\text{п}}.S$ which generates its acceleration $\vec{a}_{\text{T}}$, set it in motion for time dt at velocity $\vec{v}_{\text{T}} = \vec{a}_T.t.dt$ and performs work $dA = \vec{F}_{\text{S}}.d\vec{r}$

a) $\vec{a}_{\text{T}} = \vec{F}_{\text{S}}/m_{\text{t}}$; b) $dA = \vec{F}_{\text{S}}.d\vec{r} = \vec{F}_{\text{п}}.S.\vec{a}_{\text{T}}.t.dt$; c) $d\vec{r} = v_{\text{T}}.dt$ (4.2-3)

B. Upon a piston of a cylinder of an engine with surface S, upon the piston acts force $\vec{F}_{\text{S}} = \vec{F}_{\text{п}}.S = \vec{p}.S$ for time dt setting it in motion along distance $d\vec{r} = v_{\text{B}}.dt$ and performs work

a) $dA = \vec{F}_{\text{S}}.d\vec{r} = \vec{p}.S.d\vec{r} = p.dV$; b) $dV = S.dr$; (4.2-4)

From the presented above, the following characteristic features of the electromagnetic (thermal) radiation energy can be outlined:

1. *It is described by determinist (dynamic) laws;*

2. *It generates force (pressure) and can perform work.*

3. *Because of the emission of photons (photon gas), on the surface of the substance (the body) is generated pressure (force) directed from the surface outward perpendicular to the surface. The pressure is maximal at the surface and because of*

the diffraction it decreases with the increase of the distance r from the surface from $p_{\text{п}} = p_0$ *at* $r = 0$ *to*

a) $p = p_0\left(1 - k_{\text{p}}.r\right)$; b) $k_{\text{p}} < 1$; (4.2-5)

With two bodies with parallel surfaces $S_1 \uparrow\uparrow S_2$ and different temperature $T_1 > T_2$, body one emits power upon body two (surface $S_2 = S_1$) according to (4.2-2)a.

a) $\Pi_{12} = \sigma\left(T_1^4 - T_2^4\right) = w_{12}.c$; b) $p_{12} = p_1 - p_2 = \Delta p_{12} = \left(w_{\text{п}1} - w_{\text{п}2}\right).c$; (4.2-6)

If the surfaces are at distance r_{12}, the rejecting force (pressure) according to (4.2-6)b and (4.2-5) is (here $p_0 = p_{12}$)

$p'_{12} = p_{12}\left(1 - k_{\text{p}}.r_{12}\right) < p_{12}$; b) $F_{\text{p}} = p'_{12}.S$; (4.2-7)

It is exactly because of this pressure (force) $p'_{12} > 0$ *that the surfaces of the bodies cannot touch each other, although the force of cohesion whose attractive component is proportional to* r^{-7}*, i. e.*

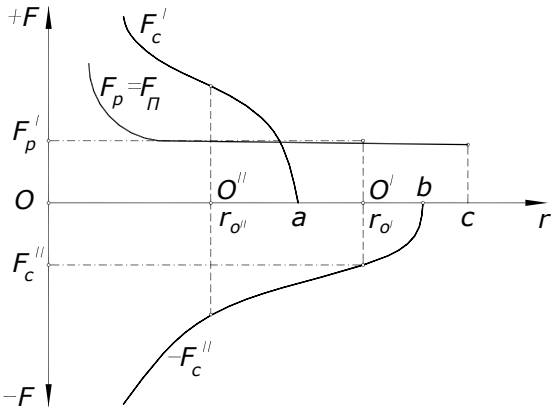
a) $F_{\text{c}} = \frac{+\alpha}{r^{13}} - \frac{\beta}{r^7} = F'_{\text{c}} + F''_{\text{c}}$; b) $F'_{\text{c}} = \frac{\alpha}{r^{13}}$; c) $F''_{\text{c}} = -\frac{\beta}{r^7}$; (4.2-8)

which decreases much faster from its initial value $F'_{\text{c}0} > 0$, at equality of its two components

a) $F_{\text{c}} = \frac{\alpha}{r^{13}} - \frac{\beta}{r^7} = 0$; b) $\frac{\alpha}{r^{13}} = \frac{\beta}{r^7} = F_{\text{ОТС}} = F_{\text{ПС}} > 0$, (4.2-9)

so F''_{c} and $F_{\text{p}} = p'_{12}$ counteract to each other, so that, at first at longer distances $r_{12} > r_{\text{b}}$ dominates the rejection of the radiation $F_{\text{p}} > F''_{\text{c}}$, but when distance r_{12} dectreases there comes a moment when the forces become equal, say, at $r_{12} = r_{0'}$ and $F''_c = F_{\text{p}}$, and after that with the decrease of the distance $r_{12} < r_{0'}$, the force of cohesion F''_c dominates, i. e.

a) at $r_{12} < r_{0'} \rightarrow F_{\text{p}} > F''_{\text{c}}$; b) at $r_{12} < r_{0'} \rightarrow F''_c > F_{\text{p}}$; (4.2-9)



- **Fig. 4.2.1.**

Fig. 4.2.1. shows an example of dependence of the forces $F_c^{'}$, $F_c^{''}$ on distance F_{p} between the surfaces. The curve F_{p} continues after $r = c$. Evidently, when r_{12} is greater than $r_{0'}$ the force of rejection of the emitted thermal (electromagnetic) energy dominates. At $r_{12} = r_{0'}$ the forces $F_{\text{c}}^{''}$ and $\left(F_{\text{c}}^{'} + F_{\text{p}}\right)$ become equal, their sum $F_{\text{c}}^{''} + F_{\text{c}}^{'} + F_{\text{p}} = 0$ with the decrease of the distance of r_{12}^{+} between $r_{0''} > r_{12} < r_{0'}$ begins to dominate the force of cohesion $F_{\text{c}}^{''}$ and the surfaces can remain stuck to each other.

This model illustrates the known experimental fact that when the external force of the pressure upon two bodies is sufficiently great they can get stuck one to another, i. e. they become one body. Therefore, the radiation energy of the bodies prevents them from getting stuck, if the pressure is not sufficiently great.

4.2.2. Mechanism of conversion of a solid body into gas

The dependence of the force of rejection F_p if it increase because of the increase in the temperature since from (4.2-2) it is evident that $F_{\text{p}} = F_{\text{п}}.{}^{\sigma T^4}\!/_{c.dt}$ and reaches a value $F_{\text{c}}^{''}$ greater than $F_{\text{c}}^{'}\left(F_{\text{c}}^{''} > F_{\text{c}}^{'}\right)$, at $T_2 >> T_1$, the force of rejection dominates and the distance r_{12} between two contiguous molecules increases to $r_{12}^{''} >> r_{12\text{B}}$. Then the molecules are without a potential force (force bonds), i. e. in a state of gas. But in an interval of r_{12}, say, $\Delta r_{12} = r_{12}^{'} - r_{12}^{''}$, the molecules have weak potential forces, because of which their bonds are weak in this interval Δr_{12} and at temperatures, say, $\Delta T_{12\text{T}} = T_{12}^{'} - T_{12}^{''}$, this is in a liquid state of the substance. Here $r_0 = r_{12} \approx 10^{-9} m$.

The substance in gaseous state and the corresponding temperature are characterized by the following data:

Exemplifying data for air

At pressure $p_0 = 1{,}01.10^5 Pa$ (one atmosphere) and temperature $T_0 = 273{,}15\ K$ = $0\,℃$.

At concentration of the molecules $n_0 = 10^{25} m^{-3}$, the distance between them is $r_{12} = 10^{-8} m$.

The volume $1m^3$ has $n \approx 10^{25}$ molecules, whose volume is $V_{\text{m}} = 10^{-6} m^3 << 1m^3$, i. e. the volume only of the molecules in 1 m^3 is $10^{-5} m^3$, which is much less than $1m^3$. But the surface S_m of these molecules with volume $V_{\text{m}} = 10^{-5} m$, which emits and absorbs photons is $S_{\text{m}} = 5.10^5 m^3$, i. e. much greater than the surface S_B of this $1m^3$, which is $S_{\text{M}} = 6.m^2 << S_{\text{M}} = 5.10^5 m^2$.

On these conditions, from the surface of the molecules S_M, at $T = T_0 = 273{,}15K = 0°C$, according to Stefan-Boltzmann law, in the form of photons, is emitted power

$$N_{\mathrm{M}} = \Pi.S_{\mathrm{M}} = \sigma.T_0^4.S_{\mathrm{M}} = 5{,}6.10^{-6}.273{,}15^4.5.10^5 = 4.64.10^7\ {}^{J}\!/_{S}; \qquad (4.2\text{-}10)$$

or one molecule emits power

$$N_0 = \frac{N_{\mathrm{n}}}{\mathrm{n}} = 4{,}64.10^7\ /_{10^{25}} = 4{,}64.10^{-18}\ {}^{J}\!/_{S}; \qquad (4.2\text{-}11)$$

To this power N_0 , according to (4.2-2)b, corresponds force of pressure (of rejection)

$$F_{12} = {}^{N_0}\!/_{\mathrm{c}} = 4{,}64.10^{-18}\ /_{3.10^8} = 1{,}54.10^{-26} N \to \left[J.m^{-1}\right] \qquad (4.2\text{-}13)$$

With the mass of one molecule at $\rho \approx T^3$

$$m_{\mathrm{M}} = \frac{V_{\mathrm{M}}.\rho_{\mathrm{M}}}{\mathrm{n}_0}\frac{10^{-6}.3}{10^{25}} = 3.10^{-29} kg\,,$$

the force generates acceleration upon one molecule of the order of

$$a = \frac{F_{12}}{\mathrm{m}_{\mathrm{M}}} = \frac{1{,}54.10^{-26}}{3.10^{-29}} \approx 5.10^2\ {}^{m}\!/_{s}\,.$$

The obtained approximate data are within the frames of the actual ones.

Since here the photons, respectively the photon gas have a significant role, this role must be clarified by explaining their properties.

4.2.3. Characteristic features of the photon gas

The following table 4.2.1. shows

Table 4.2.1.

Features of the molecules of an ideal gas and of a photon	
Molecules	**Photons**
1. $m_{\mathrm{M}} = const.$;	a) $c = const.$; b) $m_{\mathrm{f}} = {}^{W_{\mathrm{f}}}\!/_{\mathrm{c}^2} \neq const.$;
2. $W_{\mathrm{KM}} = \varepsilon_{\mathrm{M}} = \frac{p^2}{2m} = \frac{m\bar{v}^2}{2}$;	a) $W_{\mathrm{f}} = \varepsilon_{\phi} = h.\nu = p.c$; b) $m_{\mathrm{f}}.c^2$;
3. $\bar{N} = \frac{N_0}{\mathrm{z}}.\exp\left(-\frac{\varepsilon_{\phi}}{k_{\mathrm{B}}.T}\right)$;	$\bar{N} = \frac{1}{\exp\left(\frac{\varepsilon_{\phi}}{\mathrm{k}_{\mathrm{B}}}\right)-1}$;
4. $N_0 = const.$;	$N_{\mathrm{f}} \neq inv.$; $\left(N_{\mathrm{f}} \neq const.\right)$;
5. $p = m.v$	$p = m_{\mathrm{f}}.c = {}^{W_{\mathrm{f}}}\!/_{\mathrm{c}}$

The table shows the particularities of the photon gas. They are:

1) There is no distribution of the photons by momentum and velocity since here their velocity is $v = c = const.$

2) The number of the photons N_f is not constant, whereas the number of the

gaseous particles (the molecules) N_0 *is* constant.

3) The mass of the photons is not constant $m_f = W_f / c^2 \neq const.$

4) The energy of the individual photons with different $W_f \neq const.$, but the energy in the volume with ensemble of photons is constant $\sum W_{fi} = const.$.

5) With the photon gas there is no isothermal state and extension.

6) For information, the mass of the photon of the light has frequency $\nu = 10^{15}\,Hz$ and is equal to

$$m_f = \frac{h.\nu}{c^2} \approx 10^{-47}.\nu = 10^{-47}.10^{15} = 10^{-32}\,kg$$

i. e. about ~100 times less than the mass of the electron, which is $m_{e0} = 9{,}1.10^{-31}\,kg$.

The mass of a photon approaching gamma photons of frequency 10^{17} Hz is comparable with the mass of the electron

$$m_f \approx 10^{-47}.10^{17} \approx 10^{-30}\,kg$$

The power N_M (4.2-10) is the energy of the photons in a unit of volume - density of the energy of the photons w_f in a unit of volume, which is the energy of the gas in a unit of volume $w_f = w_r$.

4.2.4. Photons are generated in the following processes

4.2.4.1. In annihilation between a particle and an antiparticle and in particular in annihilation of an electron e^- and a positron e^+ the result is:

A) At velocities $v \approx 0$

a) $e_0^- + e_0^+ \rightarrow 2.\gamma$; b) $2.m_{e0}.c^2 = 2.h.\nu_0$; c) $W_f = h.\nu_0 = \frac{m_{e0}.c^2}{h}$; (I)

B) At velocity $v < c$

a) $e^- + e^+ \rightarrow 2.\gamma + (p + \overline{p})$; b) $2.m_e.c^2 = 2.h.\nu_0 + 2.m_n.c^2$; (II)

a) $e^- + e^+ \rightarrow 2.\gamma + (n + \overline{n})$; b) $2.m_e.c^2 = 2.h.\nu_0 + 2.m_n.c^2$; (III)

where: γ is photon; $p, \overline{p}\ u\ n, \overline{n}$ - proton and antiproton and neutron and antineutron.

4.2.4.2. A case of an electron colliding onto a wall at velocity $v \neq 0$. Since the velocity of the electron for time $\Delta t << 1$ from $v \neq 0$ drops to $v_1 = 0$, the result is acceleration $\vec{a}_e = \vec{v} / \Delta t$ and according to the classical electrodynamics, at $a_e \neq 0$, the electron emits power according to (1.4-1), which is

$$N_e = \frac{dW}{dt} = \frac{q_e^2.a_e^2}{6.\pi.\varepsilon_0.c^2} ; \qquad (4.2\text{-}14)$$

According to paragraph 1.4 eq. (1.4-6) at velocity of the electron $v_e \approx 10^6\,m/s$ the emitted energy is

$$\Delta W = N.\Delta t = 9.98.10^{-18}\,J$$

And at velocity $v_e = 10^2 - 10^3\ m/s$ the emitted energy is

a) $\Delta W = 9.98\left(10^{-26} \div 10^{-24}\right)$ - J; $\rightarrow$ b) $\nu = 1{,}5\left(10^8 \div 10^{10}\right) - Hz$. (4.2-15)

4.2.4.3. In exerting certain effort (pressure or extension) upon the substance, the orbitals of the electrons change their normal state and that is why they emit photons (inside or outside the substance). This is the reason why, in mechanical treatment (cutting or plastic treatment), the substance gets hot.

4.2.4.4. In friction between the surfaces of the bodies, since they are not perfectly smooth, the structural bonds of part of the molecules with the bodies tear apart, which are generated by the forces of cohesion - the derivative of Lennard-Jones potential (4.2-8). And in another part of the molecules deformations are generated in a relatively thin layer of the bodies.

These two processes result in generation of photons and heating of the surfaces of the bodies.

4.2.4.5. When the electron passes through narrow channels of the substance with dielectric constant ε different from the one ε_0 of the vacuum (air) $\varepsilon \neq \varepsilon_0$.

Two effects manifest here, as follows:

A. Because the channel in the substance has a very small radius $R << 1$, and the electron can rarely hit the center of the channel, but is closer to one of the walls of the channel, and that is why is attracted more heavily toward the wall by the force of cohesion F_c, **so that this force declines it on exiting the channel toward the wall and it declines, and does not fall upon the screen in a point opposite the channel, but aside**. Naturally, this is a real fact, if the electron does not convert into a photon after the channel.

B. In entering a channel for a very short time *dt*, or along a very small spatial interval *dr*, the dielectric constant changes from $\varepsilon = \varepsilon_0 \approx 1$ to $\varepsilon \neq 1$. Because of this fact the surrounding electric field changes significantly as well, since ε changes by *dt*

$$\frac{dE}{dt} = -\frac{q_e}{4\pi\varepsilon^2 r^2}.\frac{d\varepsilon}{dt} = -q_e \frac{A}{\varepsilon^2}.\frac{d\varepsilon}{dt};\ A = \left(4\pi\varepsilon r^2\right)^{-1}; \qquad (4.2\text{-}15)$$

In this change of the electric field, its magnetic field changes too $\vec{H} = \varepsilon\left[\vec{v}.\vec{E}\right]$, so that a system is formed which describes, say, a flat electromagnetic wave

$$\text{a)}\ \frac{d^3E}{dt^2} = c^2\frac{d^2E}{dx^2};\ \text{b)}\ \frac{d^2H}{dx^2} = c^2.\frac{d^2H}{dx^2};\ c^2 = (\varepsilon\mu)^{-1}; \qquad (4.2\text{-}16)$$

This process with the electron is manifest in reverse direction as well, from $\varepsilon \neq 1$ of $\varepsilon = \varepsilon_0 = 1$ on exiting and that is why it is not an electron at velocity v << c that exits from the channel, but a photon with energy and frequency

$$\text{a)}\ W_f = m_{e0}.c^2 = h.\nu_0;\ \text{b)}\ \nu_0 = \frac{m_{e0}.c^2}{h}; \qquad (4.2\text{-}17)$$

4.2.5. Systematized regularities from paragraphs 4.1 and 4.2

1. The atom (molecule, substance), as a result of the oscillating motions accumulates (carries inside itself) internal kinetic energy, which is identical to its thermal energy, and has density of its thermal energy, proportional to the relevant temperature.

2. In a stationary state of the system of atoms and the environment, the densities of the energies inside the atoms and in the environment are identical $\left(w_{\mathrm{A}} = w_{\mathrm{cp}}\right)$ and have slight fluctuations, therefore, their temperatures are identical, too ($T_{\mathrm{A}} = T_{\mathrm{cp}}$).

3. Regardless of the stationary or seemingly static state of the system of atoms (molecules) and the environment, the atoms always emit and absorb photons, which cause the slight fluctuations in the densities of their energies, respectively in their temperatures.

4. As a consequence of point 3 above, there is always a halo of a photon gas around the atoms (molecules).

5. When the densities of the energies w_{AT} respectively the temperatures T_A are higher than the corresponding values of the environment, i. e.

5.1. At: a) $w_{\mathrm{A}} > w_{\mathrm{cp}}$; b) $T_{\mathrm{A}} > T_{\mathrm{cp}}$; (4.2-18)

The process of emission of photons by the atoms is dominant until the moment when there is a balance, i. e.

a) $w_{\mathrm{A}} = w_{\mathrm{cp}}$; b) $T_{\mathrm{A}} = T_{\mathrm{cp}}$; (4.2-19)

5.2. At: a) $w_{\mathrm{A}} < w_{\mathrm{cp}}$; b) $T_{\mathrm{A}} < T_{\mathrm{cp}}$; (4.2-20)

The process of absorption of the photons by the atoms is dominant, which photons pass from the environment until balance is established, i. e. at (4.2-19).

7. The atom (molecule) can emit thermal energy (photons) only as long as the structure of the atom is preserved, i. e. until $T_{\mathrm{A}} > 0K$.

8. Id est there is no atom (molecule) without a thermal (kinetic) energy which does not emit and absorb such energy (photons).

9. In nature, there is no place without photons (photon gas), since natural objects always have density of energy greater than zero, respectively temperature higher than *OK* - $T > OK$.

4.2.6. Mechanism of transfer of thermal energy through a solid medium

Let us consider a wall with surface $S = 1$, temperature T_0 and concentration of molecules n_S on the surface S_1 as well as in each cross section of the wall in a plane parallel to *S* along the thickness Δ of the wall perpendicular to *S*.

In a balanced state of the wall with the environment, their temperature is T_0.

According to statistical physics, on the above conditions, each molecule contains the quantity of thermal energy W_{km}, and according to M. Planck, to this electromagnetic energy corresponds the energy of the photon ensemble (gas) with energy W_v, as follows

$$W_{\text{КМ}} = \frac{m\bar{v}^2}{2} = k_{\text{Б}}.T_0 = W_0 = h\sum_{i=1;\,j\neq 0}^{i=n;\,j<10^{20}} \nu_{\text{ij}} \; ; \qquad (4.2\text{-}21)$$

where: h is Planck's constant; $\nu_{\text{j}} - j^{-mama}$ the frequency of the photon (with number j), and i is the number of the photons with identical frequency ν_i; the frequency here is limited to the one of the gamma photons.

Let upon the external layer of molecules n_S at $S = 1$ falls a thermal flux of photons according to Stefan-Boltzmann law

$$\text{a)}\ \frac{dW_{\text{n}}}{\text{dt}} = \Pi = \sigma.T^4 = \frac{w_{\text{n}}}{4}.c\ ;\ \text{b)}\ w_{\text{n}} = {}^{4\Pi}\!/_{c}\ ; \qquad (4.2\text{-}22)$$

where: $w_{\text{п}}$ is the density of the thermal energy carried by the photons, emitted from the surface of another object with temperature T; c - velocity of the photons (electromagnetic waves - the light).

To w_n corresponds the density of the mass of thermal (electromagnetic) energy - ρ_{n} and the density of the thermal momentum $\vec{P}_{\text{n}}$

$$\text{a)}\ \rho_n = {}^{w_{\text{n}}}\!/_{\text{c}^2}\ ;\ \text{b)}\ \vec{P}_{\text{n}} = \rho_{\text{n}}.\vec{c} = \frac{w_{\text{n}}}{\text{c}}.\vec{c}_0\ ;\ \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|}\ ; \qquad (4.2\text{-}23)$$

To the derivative of $\vec{P}_{\text{n}}$, relative to time, corresponds a thermal force upon a unit of surface ($S = 1$), which is also pressure $\vec{p}$

$$\text{a)}\ \vec{F}_n = \frac{d\vec{P}_{\text{n}}}{\text{dt}} = \frac{d\rho_{\text{n}}}{\text{dt}}.\vec{c} = \frac{dw_{\text{n}}.\vec{c}_0}{\text{c.dt}} = \frac{dw_n}{dr}.\vec{c}_0 = \vec{p}\ ;\ dr = c.dt\ ; \qquad (4.2\text{-}24)$$

On these conditions, when the molecules have surface energy $W_{\text{КМ}} = W_{\text{V}}$ and surface temperature T_0 and the energy of radiation $\vec{\Pi}$ (4.2-22) falls upon them, which is, for one molecule, $W_{\text{ПМ}} = {}^{\Pi}\!/_{n_{\text{S}}}$, the quantity of the thermal energy of the molecule increases to

$$\text{a)}\ W'_{\text{КМ}} = W_{\text{КМ}} + W_{\text{ПМ}} = k_{\text{Б}}.T' > k_{\text{Б}}.T_0\ ;\ \text{b)}\ \Delta T = T' - T_0 = \frac{W_{\text{ПМ}}}{\text{k}_{\text{Б}}}\ ; \qquad (4.2\text{-}25)$$

and it continues (with the time) to increase to $W'_{\text{КМ}}$, T' being higher than the temperature T_0 of the molecules in the contiguous layer, which is at distance $\Delta r << 1$, because of which according to Maxwell's pressure or the law (4.2-22) the first layer (of the surface) emits energy $\Delta W_{\text{П12}}$ toward the second at temperature $T_0 < T'$

$$\Delta W_{\text{П12}} = \tau.\left(T'^4 - T_0^4\right) = \Delta W'_{\text{T}}\ ; \qquad (4.2\text{-}26)$$

until the temperatures become equal - $T_0 = T'_0 = T'$.

Or the same dependence, obtained for the layer with surface S through Fourier's law, is

$$\text{a)}\ \Delta W_{\text{П12}} = -\lambda.\frac{\left(T' - T_0\right)}{\Delta\text{r}}\ ;\ \rightarrow \text{b)}\ F_{\text{T}} = -\lambda.\frac{dT}{dr}\ ; \qquad (4.2\text{-}27)$$

Evidently, this deterministic process continues in the wall until its passes its thickness Δ and is emitted out of its other side, on condition that the temperature of the surface (at the end of Δ) is $T_\Delta > T_{ср}$ of the environment.

According to I. Newton's law for convection radiation thermal energy $W_{ТЛ}$ is given away from the wall at $S = 1$, which is

$$W_{ТЛ} = \alpha\left(T_\Delta - T_{ср}\right) = \alpha.\tau\ ;\ \tau = T_\Delta - T_{ср}\ ; \qquad (4.2\text{-}28)$$

where: α is a coefficient of thermal release in radiation and convection.

Evidently, after the photon flux has generated force and pressure, it can also perform work at $S \neq 0$

$$\text{a)}\ A = \int \vec{F}_П.d\vec{r}\ ;\ \text{b)}\ A = \int \vec{p}.S.d\vec{r} = \int p.dV\ ; \qquad (4.2\text{-}29)$$

To motivate its capability to do so, Carnot's cycle is not needed. On these conditions, Carnot's cycle is already an archaism, since it cannot be realized in practice – it is not a reality, but a chimera.

4.2.7. Some concrete manifestations of the photon gas

In principle, at the level of the material manifestations of thermal energy, it almost always is conveyed in the form of a photon gas (ensemble of photons), which is generated or absorbed by the substance. However, depending on the structure (construction of the system of material objects in which photons are manifested-(generated or absorbed), as a result of the changes in the energy, relevant forces (of pressure or extension) of Maxwell's pressures appear and different effects are generated. For example:

a) When exerting pressure (in mechanical treatment of materials), since the pressure is stress

$$p = \frac{F}{S} = \frac{force}{surface} = \frac{\left[J.m^{-1}\right]}{\left[m^2\right]} = \frac{\left[J\right]}{\left[m^3\right]} = w = \textit{density of the energy;}\ (4.2\text{-}30)$$

i. e. a flux of photon gas is generated with density of the energy $w = p$.

This energy interacts (presses on) with the molecules, which are bound through the force of cohesion F_c (which is derivative of Lennard-Jones potential (4.2-8)) and when it weakens the bond sufficiently, the bond between the molecules disintegrates. This is the electromagnetic essence of the mechanical treatment of materials. But in ancient times this essence was not clear and this electromagnetic process was called a mechanical process without clarifying the essence of the mechanism of cutting or the essence of the forces.

b) A photon gas (energy) is introduced into the substance; as a result of this the structural bonds between the molecules are loosened and they are restructured, after which the substance is quickly cooled or not, but it gets cool with a different structure between its molecules; this is the essence of thermal treatment of materials.

c) In the example b) if when the structures are loosened another material is introduced, this is also thermal treatment, but with introduction of another material.

d) *With macromolecules, there is a constant emission and absorption of photons by the atoms in different direction; because of this fact, the parts of the*

macromolecules are always in motion one relative to another, as well as the macromolecules themselves. Some scientists call the forces, which generate photons Van der Waals forces. *But these are purely electromagnetic forces generated by the photon gas.*

Depending on the configuration of these forces, generated by the photon gas, the structures of the macromolecules are formed.

These forces can be very weak, but they are sensitive to the forces of the external photon gas, which easily restructures them (the eye retina), as is with biomacromolecules. That is why living organisms are sensitive to thermal phenomena.

e) As for the mechanism of how humans feel the thermal energy of the photon gas (photons), there is certain analogy to the presented in point b), but is associated with the organs of perception and their signals in the brain. The weak heating (a slight density of the photon gas) results in: 1) loosening of the bonds inside the cells of the human matter and outside them resulting in improvement of metabolism and blood supply; 2) when the density of the photons increases and the destructive forces start disintegrating structural bonds – pain is felt; 3) when the destruction of structural bonds is serious or irreversible, including that of the blood supply, the pains become constant, some living cells die – there is a wound, partial decay and microbial action – medical treatment is required.

4.2.8. Final inferences to chapter 4

First. **Thermal energy is electromagnetic energy and the laws of Maxwell's electromagnetic theory hold true with it, with taking into account its specific feature that its main dynamic manifestation is in the form of a photon gas, and in a localized state, it its carriers are the electrons in atoms in the form of the magnetic energy of the electrons.**

Second. Thermal energy, as well as all other structural states of the energy, which is only electromagnetic, can convert (restructure) from one state into another, whereby retaining their quantities. In *this conversion, the initial state is called energy, and the converted one (the restructured one) is called work.* That was the reason why Newton determined that the energy *dW* was measured by the performed work *dA* through the product of (4.2-31) the force $\vec{F}$ by the distance *dr,* i.e.

a) $dW = dA = \vec{F}.d\vec{r}$; b) $\vec{F} = \frac{dA.\vec{r}_0}{\mathrm{dr}} = \frac{dW}{dr}\vec{r}_0 = \frac{d\vec{P}}{dt}$;

i. e. the work is the new state of the energy.

Third. **Inside the substance, the dynamic state of thermal energy in the form of photons is kinetic energy, which should be called internal wave kinetic energy, which is described by force or by momentum or by pressure.** That is why gases (vapors) perform work – they convert part of their internal wave energy into external energy by setting a certain object into motion.

Fourth. The description of the thermal processes is in a deterministic form as dynamic laws or through statistical physics be means of statistical laws.

4.2.9. Predictive recommendations

1. In principle, because of the practically unlimited number of thermally interacting objects at a microlevel, their analysis as deterministic processes is impossible. The main reason for this is that in physics the issue of describing the energy interactions of more than two objects has not been solved yet, and at a microlevel they are practically unlimited in number.

That is why the microprocesses are treated as probabilistic moment values of their energy states.

2. For this purpose are used the facts (the laws) that:

2.1. For a certain interval of time, the interval probabilistic processes at a microlevel has a deterministic value.

2.2. The effective result of the sum of the microprocesses of a macroobject for a finite interval of time has a deterministic value. That is why the thermal processes are a deterministic macromanifestation with very slight fluctuations, of the order of $\Delta \approx 10^{-9}$ of the temperature in Kelvin degrees, *K*.

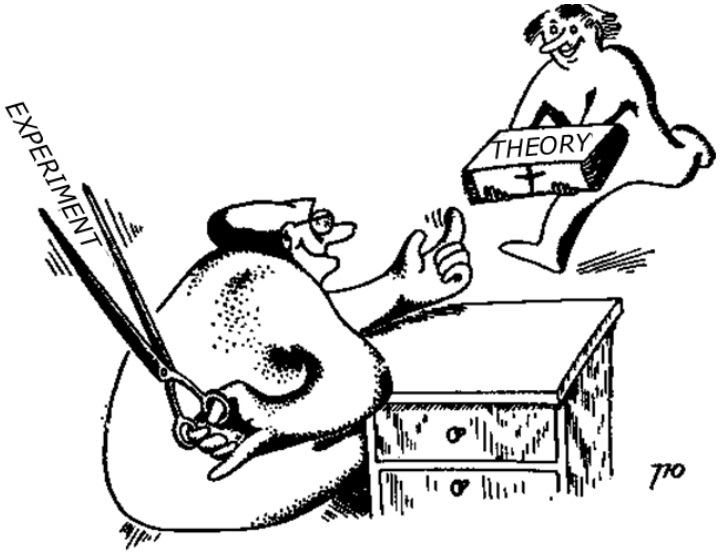
For example. The probabilistic description of the velocities of the gaseous particles is one, but the effective work, which the gas performs is described by deterministic laws.

3. We recommend that the presented in chapter 4 be developed in a detailed description of the thermal electromagnetic phenomena by means of the deterministic laws of electrodynamics. This is also the requirement of a physics of the unitary principle – the electromagnetic principle, as the physics of the 21st century.

Supplements

This critical presentation of the supplements is not because of the author's evil will, but because of the irresistible power of the logic of complex analysis and experimental data, which are the criterion of veracity for each theory.

This criterion is not an accidental choice but it has been established in the course of thousand of years of scientific development, because science is a self-regulating system based on experimental data – criteria of veracity.



J. E. Geguzin. Animated crystal. " Science ", 1981.

1. Supplement I
Flaws in Michelson – Morley's experiment

1. Introduction

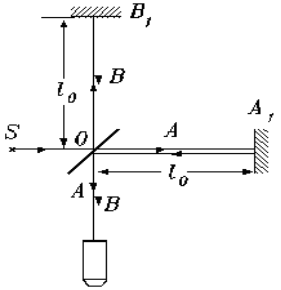
The purpose of Michelson – Morley's experiment (MME) was to establish whether luminiferous ether exists as per Fresnel's hypothesis of 1816. MME was first arranged and conducted in 1881 by Michelson alone, and then was conducted together with the chemist Morley and independently by many other scientists, even more precisely. But the results showed only that, as Michelson according to [1] (p. 215) put it: "*The interpretation of the results from the experiment lead to the conclusion that there is not any shift in the strips of interference. This fact shows the*

flaw of the hypothesis of immovable ether and leads to the conclusion that this hypothesis is wrong." In [2] Einstein wrote: „The negative result of this experiment (he referred to MME – P. P.'s note), shows that with respect to the inertial coordinate systems in vacuum, light propagates at constant velocity, which does not depend on the velocity of motion of these systems."

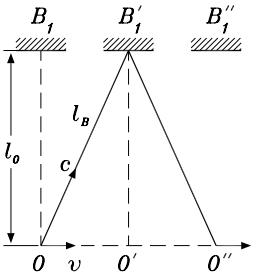
Despite the evidence that the MME setup of 1881 does not meet the experimental results, it has not been analyzed with respect to its wrongness, and most scientists have only made the conclusion that there is no immovable luminiferous ether. Here some analysis will be made to point out the errors in Michelson's setup of MME.

2. MME setup according to Michelson

The setup is given according to the description of MME by Max Born in [4] (chapter V, paragraph 14). The scheme of the interferometer is on Fig. 1a, where are arms A and B. The reflective mirrors are A_1 and B_1 at the ends of the arms, l_0 the length of the arms A and B.



- **Fig. 1a**



- **Fig. 1 b**

The time of motion of the beam along the length l_0 of the arm A, which is parallel to the velocity of the Earth $v_з$, along which moves the light, whose velocity of emission is c, at a velocity in straight direction from O toward A_1 is $u_{0A} = c + v_з$, and in reverse direction $u_{A0} = c - v_з$, e

$$t_A = l_0\left(\frac{1}{c+v_з} + \frac{1}{c-v_з}\right) = \frac{2.l_0}{c^2 - v^2}; \qquad (2\text{-}1)$$

To compute the time of motion of the light along the arm in - Fig. 1b, it is assumed that along the hypotenuse the velocity is c, and the perpendicular velocity, at which the light moves is $c' < c$, and along the direction of the motion of the interferometer, at the velocity of the earth $v_з$.

On the above conditions Born fitted

$$\text{a) } c^2.t_B^2 = l_0^2 + v_з^2.t_B^2\text{; b) } c^2 = \left(\frac{l_0}{t_B}\right)^2 + v_з^2 = c'^2 + v_з^2; \qquad (2\text{-}2)$$

whereby in the direction perpendicular to $v_з$, in which light is emitted at velocity c, Michelson assumed that light moves at velocity c', whose value from (2-2) is

$$\text{a) } c'^2 = c^2 - v_з^2 < c^2 \text{; b) } c' = \left(c^2 - v_з^2\right)^{1/2}; \tag{2-3}$$

On these conditions, the time of movement of the light in straight and reverse direction according to Michelson is

$$\text{a) } t_B = \frac{2.l_0}{c.\left(1 - \beta^2\right)^{1/2}} \text{; b) } \beta = \frac{v_з}{c}; \tag{2-4}$$

or using the approximate formulae

$$\text{a) } \frac{1}{1-\beta^2} = 1 + \beta^2 \text{; b) } \frac{1}{\left(1-\beta^2\right)^{1/2}} = 1 + \frac{\beta^2}{2} \text{; b) } \beta = \frac{v_з}{c}; \tag{2-5}$$

for the difference between the times $t_A - t_B$, he wrote

$$\Delta t_{AB} = \frac{2.l_0}{c}\left[\left(1+\beta^2\right) - \left(1 + \frac{\beta^2}{2}\right)\right] = \frac{2.l_0}{c}.\frac{\beta^2}{2} = \frac{l_0}{c}.\beta^2; \tag{2-5}$$

and he gave for example the MME of 1887 at $l_0 = 11\ m$, $\lambda = 5{,}9.10^{-7}\ m$ then $\beta = 10^{-4}$, and $\beta^2 = 10^{-8}$

$$\frac{l_0\beta^2}{c} = \frac{2.l_0.B^2}{\lambda} = 0{,}37; \tag{2-6}$$

Michelson was convinced that the preciseness of the interferometer was such that it could measure with preciseness of 0,01. But it turned out that MME did not give anything. Max Born* wrote: "The velocity of light is not influenced by the velocity of the earth. Even at the second order in Michelson's experiment there is no ethereal wind".

3. Analysis of the flaws in MME

3.1. Level of knowledge at the time of conducting MME

First.

The measurement of the velocity c of light through the experiments with the motion of light in straight and reverse direction was done much earlier and if there had been immovable ether, the measurement was done with that ether.

Second.

According to Galileo's principle of relativity, the phenomena in a frame of reference do not depend on the circumstance whether the system is at rest or in constant motion at constant velocity. When this principle was established, if there had been immovable ether, the principle was valid with that ether.

Third.

According to Doppler's effect – DE, the velocity of the emitted wave processes

---

* Max Born. Einstein's Theory of Relativity. Dover Publicatione, Inc. New York. 1962.

(light and mechanical - sound) does not depend on the state of the transmitter and is constant relative to it. There had been experimental data that this was really valid for the light whose velocity was measured with immovable ether, if there had been such.

3.2. Analysis and inferences

Since: a) on the one hand, the velocity of light during emission has a constant value, relative to the interferometer, which does not depend on the motion of the interferometer, which is immovable relative to the Earth, and b) on the other hand, the transmitter and the receiver (say, point 0 and point A_1 on Fig. 1a), are stationary one relative to another, and the ether is immovable, too, the corollary from this is that its velocity is constant and relative to the receiver, regardless of the velocity of the Earth. Einstein in [3] (in the introductory part) wrote: "The velocity of light in vacuum always propagates at velocity c, which does not depend on the state of the motion of the transmitter."

On these conditions, a categorical conclusion follows that the equations for t_A (2-1) and for t_B (2-3) are incorrect.

Moreover, in the equation for t_B (2-2) there is a very serious error, because Galileo's principle of relativity was not fulfilled when summing the velocities, and was used the principle for constancy of the velocity of light, but incorrectly, which is evident in its notation in (2-2)b

$$\text{a)}\ c^2 = \left(\frac{l_0}{t_B}\right)^2 + v_з^2 = c'^2 + v_з^2\ ; \rightarrow \text{b)}\ c'^2 = c^2 - v_з^2\ ; \qquad \text{(2-2)a}$$

regardless that by condition $c' = c = const.$

Here the motion of light along arm B at velocity of emission c is notated at velocity c'

$$c' = \left(c^2 - v_з^2\right)^{1/2} < c\ ; \qquad \text{(3-1)}$$

which is inadmissible.

This flaw becomes even more conspicuous when we consider an analogous model of a river with a width l_0, velocity of the water $v_B = const.$ and velocity of a boat $v_L = const.$, which is perpendicular to the shore and to the velocity of the water v_B, which is parallel to the shore.

On these conditions, regardless of the velocity of the water v_B, the boat will cover distance l_0 from one to the other shore for time

$$t_0 = \frac{l_0}{v_L}\ ; \qquad \text{(3-2)}$$

i. e. regardless of velocity v_B

But depending on the velocity of the water v_B the place of arrival of the boat at the other shore will shift by distance

$$\Delta l = v_B.t_0 = \frac{v_B}{v_L}.l_0\ ; \qquad \text{(3-3)}$$

relative to the point on the shore, which is perpendicular to the point of departure.

In this case, the equation analogous to (2-2)a is

a) $l^2 = l_0^2 + \Delta l^2 = (t_0.v_0)^2 + (t_0.v_B)^2$; b) $v_e = \left(\frac{l}{t_0}\right)^2 = v_L^2 + v_B^2$; (3-4)

and in (2-2)a, the velocity of the boat from v_L is assumed to be $v_L^{'}$, therefore

$$v_L^2 = v_L^{'2} + v_B^2 ; \quad (3\text{-}5)$$

In this respect, as presented here, the flaws in the setup and assumptions of MME are:

a) **non-observance of the principle of relativity;**

b) **non-observance of the laws of the Doppler effect;**

c) **non-observance of the law that the velocity of light does not depend on the state of motion of the transmitter.**

3.3. Computations for the motion of light along arm A

Here, first of all, it is necessary to emphasize the fact that the whole setup of the interferometer with the source and the analyzer of the light as a construction of one system are one block in which all elements are stationary one relative to another. In this respect, the distances l_0 between the transmitters and the receivers of the light for each arm are constant, too, i. e. the transmitters and the receivers are stationary one relative to another. At each arm A and B, as well as arms A and B one relative to another

3.3.a) On these conditions the light c emitted by the transmitter in point O with a velocity c relative to the ether, which is immovable, but the transmitter moves at the velocity of the Earth $v_з$ relative to the ether. Because of this circumstance and since the velocity of light relative to O is c , its generating frequency ν_0 , and length of the wave λ_0 are changed

a) $\nu^{'} = \nu_0 \frac{c - v_з}{c}$; b) $\lambda^{'} = \lambda_0 \frac{c}{c - v_з}$; c) $c = \nu^{'}.\lambda^{'} = \nu_0.\lambda_0 = c$; (3.6)

With these $\nu^{'}$ and $\lambda^{'}$ and at velocity c , light moves relative to the interferometer (point O on A_1) and the ether until it reaches the receiver in point A_1. But since the receiver A_1 moves at velocity $v_з$ in direction of the light, the light, before reaching A_1, will have covered the distance l_0 and also the distance $\Delta l_{A0} = v_з.\Delta t$, until it reaches the receiver A_1 with parameters according to (3-6). Or for time t_{A0} the light will cover distance $l_{A0} = l_0 + v_з.\Delta t$ at velocity c. Hence

$$t_{A0} = \frac{l_{A0}}{c} = \frac{l_0}{c} + \frac{v_з.\Delta t}{c} ; \quad (3\text{-}7)$$

As a consequence of Doppler's effect ν_H and λ in the receiver A_1 are

a) $\nu^{''} = \nu^{'}.\frac{c}{c - v_з}$; b) $\lambda^{''} = \lambda^{'}.\frac{c - v_з}{c}$; c) $c = \nu^{''}.\lambda^{''} = \nu_0.\lambda_0 = c$; (3-8)

i.e. ν_0 *and* λ_0 *are restored in the receiver because of the fact that the distance between O and* A_1 *is* l_0 *= const. or because the transmitter O and the receiver* A_1 *are stationary one relative to another.*

3.3. b) When the beam of light reflects back in direction from A_1 toward O, the parameters of the reflected beam are

$$\text{a) } \nu''' = \nu_0 \frac{c + v_з}{\text{c}} \text{; b) } \lambda''' = \lambda_0 \frac{c}{c + v_з} \text{; c) } c = \nu'''.\lambda''' = \nu_0.\lambda_0 = c \text{;} \qquad (3\text{-}9)$$

i. e. *in the reverse direction the light moves at velocity c both relative to the ether and relative to the interferometer, respectively relative to the transmitter A_1 and receiver O.* It reaches the transmitter O, which in this case 3.3.b) is a receiver, having covered, at velocity c, distance l_0 minus distance $v_з.\Delta t$, since in this case the receiver O moves at velocity $v_з$ in reverse direction of the velocity of the light toward O. Or the covered distance is $l_{\text{A0}} = l_0 - v_з.\Delta t$ at velocity c for time

$$t_{\text{A0}} = \frac{l_{\text{A0}}}{\text{c}} = \frac{l_0}{\text{c}} - \frac{v_з.\Delta t}{c}; \qquad (3\text{-}10)$$

The resultant time of motion of the light in straight $\overline{OA}$ direction and reverse $\overline{AO}$ direction is

$$t_{0\text{A0}} = t_{\text{OA}} + t_{\text{AO}} = \frac{2.l_0}{\text{c}}; \qquad (3\text{-}11)$$

Id est, irrespective of whether there is ether or not, the time of motion of the light $t_{0\text{A0}}$ along arm A is identical, according to Galileo's principle of relativity - GPR and DE. The FISO experiment is another question. Here two individual beams, which move in two identical medium, but in two different places, because of which the attractions of the beams (the members $v_з.\Delta t$ and minus $v_з.\Delta t$) by the medium are not compensated and that is why the result is different.

4. Conclusion

With the above flaws of MME and the fact that it does not give any new information, MME is nowadays anachronism in physics and the practice of describing it as a scientific fact should be terminated because of its serious flaws.

Literature

1. V. M. Dukov. Electrodynamics: Vishaya shkola. Moscow. 1975 (in Russian)

2. A. Einstein. New experiments on the influence of Earth movement on the velocity of light related to Earth. CSW* v. 2 (p. 188). Nauka, Moscow, 1966 (in Russian). Translated from German: Neue Experimente ueber den Einfluss der Erdbewegung auf die Lichtgeschwindigkeit relativ zu Erde. Forsch und Forschritte.1927.336.

3. A. Einstein. On the electrodynamics of moving bodies. CSW. v. 1 (p. 7), Nauka, Moscow, 1966 (in Russian). Translated from German: Zur Elektrodynamik der bewegter Körper. Ann. Phys. 17.891-921.

4. Max Born. Einstein`s Theory of Relativity. Dover Publications. Inc. New York. 1962.

* A. Einstein. Collected Scientific Works in Four Volumes (in Russian)

2. Supplement II
Unreality of the theory of relativity

In actual reality, there has never been a reliable theory of relativity based on the principle of constancy of the velocity of light, PCSL, for Einstein did not applied it to the formulae in [7].

1. General assumptions

Theory of relativity - TR, consists of two sections, which were set forth in 1905 and 1916, respectively. The first section of TR is called Special theory of relativity - STR of 1905 in the article [7] and is the first stage of the TR development and (as Einstein wrote) is the basis of the electromagnetic theory of Maxwell - Lorentz.

The second section of the TR development is called General theory of relativity - GTR of 1916, in the article [17]. This is an attempt to summarize the STR by a new theory of gravitation. but GTR remains unfinished because of the unsuccessful attempts to unite the electromagnetic field with the new theory of gravitation or Einstein put is, the GTR refers only to the theory of gravitation in limited conditions.

The initial assumptions of TR are determined by Einstein's citations:

1. In [18] he writes: "The theory, which is presently called „Theory of relativity", is based on two principles, which are completely independent, namely:

1. *Principle of relativity about a constant and straight linear motion.*

2. *Principle of constancy of the velocity of light."*

II. In [4] he writes: "By uniting the law of constancy of the velocity of light in vacuum with the principle of relativity, in a purely deductive way, we obtain a theory which is now called „theory of relativity."

III. In [2] he writes: "*The fundamental Lorentz's statement that every light beam propagates in vacuum at constant velocity, we shall call the principle of constancy of the velocity of light* (for brevity - PCSL – P. P.'s note)."

According to these citations, the initial assumptions of TR are:

a) *Galileo's principle of relativity - GPR*;

b) *The principle of constancy of the velocity of light - PCSL.*

2. Section one. Special theory of relativity - STR

The fundamental Einstein's citations about STR are:

2.1. On PCSL

IV. In [3] he writes: "The other principle on which the special theory of relativity is based, is *the principle of constancy of the velocity of light in vacuum. According to this principle, light always propagates at the same velocity in vacuum (regardless of the state of motion of the source and the observer)."*

V. In [5] he writes: **"Therefore, when we add to the velocity of light another velocity smaller than c, we obtain again the velocity of light c."**

VI. In [6] he writes: *"We remember that the velocity of light is the same related to all inertial frames of reference. This fact is incongruent with the classical transformations."* Here, by classical transformations are meant Galileo's transformations - GT.

"According to the classical transformations this velocity is not the same related to two systems, which move one toward the other" (then the Doppler Effect is generated - (P. P.'s note). And **further: "The laws of nature are invariant not with respect to the classical transformations, but with respect to the new type of Lorentz transformations - LT**, **and the transition from one system to another is carried out through the lengths.**" and further on he writes: **"This means that the rhythm of the moving watches and the length of the rods depends on their velocity."**

Citations IV, V and VI imply that the mathematical notation of PCSL related to IFR-K, which moves at velocity $|\vec{v}| < |\vec{c}|$ is

$$\text{a) } \vec{u}_c = \vec{c} + \vec{v} = \vec{c} = const.\text{; b) } v = 0\text{;} \qquad (2\text{-}1)$$

In [15] in supplement I, Einstein, proceeding from PCSL in a notation of H. Minkowski concerning two inertial frames of reference - IFR-K and IFR-K' notates PCSL in the form

$$\text{a) } x = c.t\text{; b) } x' = c.t'\text{; } \rightarrow \text{c) } x - c.t = 0\text{; d) } x' - c.t' = 0\text{; e) } \frac{x}{t} = \frac{x'}{t'} = c\text{;} \qquad (2\text{-}2)$$

and deduces Lorentz transformations - LT, which are

$$\text{a) } x' = \frac{x - v.t}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}}\text{; b) } y' = y\text{; c) } z' = z\text{; d) } x' = \frac{t - \frac{v.x}{c^2}}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}}\text{;} \qquad (2\text{-}3)$$

And from LT Einstein deduces the law of addition of velocities

$$u_c = \frac{v + w}{1 + \frac{v.w}{c^2}}\text{;} \qquad (2\text{-}4)$$

In [7] he writes:

VII. "*… it turns out that even in infinitely small space-time areas, Lorentz transformations do not hold true, if we reject the idea of the constancy of the velocity of light c."*

In [7] Einstein specifies the physical sense of PCSL, by writing in paragraph 5: "Further on **it implies that when we add the velocity of light c to a velocity, which is smaller than the velocity of light, it cannot change."**

By this statement Einstein believed that he had confirmed the formula of addition of velocities, which is obtained from LT, by assigning in (2-4); $v < c$ *and* $w = c$, at w parallel of v, we obtain

a) $u_c = \dfrac{w+v}{1+\dfrac{w.v}{c^2}} = \dfrac{c+v}{1+\dfrac{v}{c}} = \dfrac{c+v}{c+v} = c = c$; b) $v = 0$; (2-5)

Here, in the analysis of (2-5), the emphasis is on the simplified mathematical notation of PCSL at $v << c$, which will be used most often

$$u_c = c + v = c = const.\,; \quad (2\text{-}6)$$

i. e. in all formulae of TR the term ($c + v$) must be reduced to c as a result of (2-5), since: *First,* PCSL is defined; *Second* LT are deduced from it; *Third,* from LT is deduced the law of addition of velocities (2-4). In (2-4) it is assigned $w = c$, $v < c$ and is obtained c. I. e. by proceeding from PCSL and through various mathematical operations, again is obtained PCSL. *This is a closed vicious circle, since the proof is the initial principle.* **From a scientific point of view (2-5) is not a proof of PCSL, since (2-5) is a result of PCSL.**

Emphasis

The equation (2-5) is flawed, because it was wrongly assumed in equation (2-4) that one velocity is equal to the velocity of light "c". Because of this circumstance, (2-5) does not a prove that is a real law.

The considerations to point out this flaw are:

First. The formula (2-4) was derived in [15] in paragraph 13 through Lorentz transformations, LT, and described by formula (B) in [15].

Second. Einstein derives LT in [15] (in supplement I) proceeding from PCSL, which principle he describes here as H. Minkowski about two inertial systems *K and K′* with the formulae (2-2) and, by processing it, he obtains LT (2-3).

Third. Assuming $v = c$ in the terms a) and d) of LT (2-3), by taking into consideration the notations b) and d) of the PCSL notation (2-2) results into the indeterminations:

a) $x' = \dfrac{x - c.t}{\left(1 - c^2/c^2\right)^{1/2}} = \dfrac{0}{0}$; d) $t' = \dfrac{c.t - x}{c\left(1 - c^2/c^2\right)^{1/2}} = \dfrac{0}{0}$; (A)

Inferences

1. Comparing LT with Galileo's transformations, GT, it is evident that LT do nlot hold true at velocity $v = c$, whereas GT hold true even at $v = c$. In this sense, GT are more universal than LT.

2. On account of deduction 1., solution (2-5) is wrong, i.e. it does not prove that PCSL is actually existing. Michelson-Morley's experiment (see supplement I) does not prove PCSL, either, and, in general, there is no experimental validation of PCSL. Moreover, Einstein himself never applied it in STR; he applied GT instead, which leads to the

Conclusion

PCSL is not a reality. This fact leads o the conclusion that the Special Theory of Relativity, STR, cannot be proved, either, i.e. as an actual fact, there is no STR nor has there ever been STR; STR is only a chimera.

From the above presentation of the STR, these principles emerge:

1. *The velocity of light is constant and equal to c, related to all inertial frames of reference - IFR-K, regardless of the fact that they have different velocities, i. e. the notation (2-6) of PCSL always holds true.*

2. *From PCSL are deduced new transformations - LT, which should be used instead Galileo's transformations - GT.*

3. *The laws of nature are invariant during the transition from one IFR-K to another IFR- K' only through LT, and in [15] he writes:*

IX. "**The theory of relativity offers transformations, which satisfy both the principle of relativity - PR and PCSL. The new equations of transformations postulate the physical requirement that any light beam should propagate in both systems K and K' at the same velocity."**

2.1.1. A brief analysis of the proof for PCSL by Einstein

First. *On the criterion of veracity and proof of PCSL*

Einstein, in [14] and [15] respectively, in citations X, XI and XII stated:

X. **"Naturally, the experiment remains the only criterion of the fitness of mathematical constructions to physics."**

XI. **"The first criterion of veracity is apparent. The theory should not contradict the empirical data."**

XII. „**So that a theory could be considered a physical theory, it is necessary that its claims allow empirical validation."**

And in [11] and [13], by the citations XIII and XIV respectively, he states:

XIII: "It is well known from the interferential experiment of Michelson (a.k.a. Michelson and Morley)… *The negative result of this experiment has shown that, in an inertial coordinate system, light propagates at constant velocity, which does not depend on the velocity of motion of that system."*

XIV. The law of the constant velocity of light … is especially clearly emphasized in Michelson – Morley experiment - MME."

However, the analysis of Michelson - Morley experiment, MME, in supplement I shows that MME proves that only Galileo's principle of relativity holds true for light, and nothing else.

The reason for this denial of the citations XIII and XIV is the fact that the interferometer of Michelson consists of body with immovable, one related to other, parts – both the arms, which are perpendicular one to another, and the distances between the transmitters and the receivers are constant, i. e. the transmitters and the receivers are stationary one related to another. And as a result of the universal law of wave processes, including the law of light, which Einstein cited in the introduction of [7], *the velocity c of the wave processes does not depend on the state of motion of the transmitter, but only the frequency ν and the length of the wave $\lambda = c/\nu$ change,* so that the velocity of the waves for a given transmitting system is

$$c = \nu_1.\lambda_1 = \nu_2.\lambda_2 ... \nu_i.\lambda_i ... \nu_n.\lambda_n = const.; \qquad (2\text{-}7)$$

Because of this law and the circumstance that in MME the transmitter and

the receiver are stationary one related to another (even if there were luminiferous ether) the mean velocity in both directions is

$$u_{\mathrm{m}} = c - v + c + v = c = const.; \qquad (2\text{-}9)$$

I. e. the velocity of light actually measured in MME was in fact *c = const.*

That is why MME validates only that Galileo's principle of relativity holds true for light, too.

In the above sense MME has nothing to do with PCSL because it does not validate it at all.

Second. *Here comes the question, in using PCSL, is the law of energy conservation observed?*

For convenience, in the analysis of PCSL, the notation from (2-6) is also used when the velocity c is replaced by the product $\nu.\lambda$, then (2-10)b follows.

$$\text{a) } u_{\mathrm{c}} = c \pm v = c = const.; \text{ b) } u_{\mathrm{c}} = \nu.\lambda \pm v = \nu.\lambda = c = const.; \qquad (2\text{-}10)$$

The energy of the photon in IFR-K is analyzed, with frequency ν_0 and energy, at Planck's constant - *h*, which is

$$W_{\mathrm{f0}} = h.\nu_0; \qquad (2\text{-}11)$$

According to classical physics, during the motion of the photon related to IFR-K', which moves at velocity *v* parallel to *c*, Doppler effect holds true because of which the frequency of the photon changes from ν_0 to ν', and thence also its energy

$$\text{a) } \nu' = \nu_0 \frac{(c+v)}{c}; \text{ b) } W'_{\mathrm{f}} = h.\nu' = h.\nu_0.\frac{(c+v)}{c}; \qquad (2\text{-}12)$$

And if PCSL is applied to ν', it is reduced to ν'', and along with it, the energy is also reduced to W''_{f}, as follows

$$\text{a) } \nu'' = \nu_0 \frac{c}{c} = \nu_0; \text{ b) } W''_{\mathrm{f0}} = h.\nu'' = h.\nu_0 = W_{\mathrm{f0}}; \qquad (2\text{-}13)$$

It turns out that, according to PCSL, there is no change of ν *and of* W_f*, and that in actual practice the experiment validates (2-12), i. e.* **the experiment denies PCSL, since it contradicts the law of energy conservation - LEC.**

More examples can be given, which also categorically deny PCSL, whence it follows that **it is not a real natural law, but only** a figment invented by H. Lorentz and A. Einstein.

By the formula (2-13) in essence, PCSL denies Doppler effect, DE, for light as well, although it was not experimentally validated for light in 1867. Einstein himself, in paragraph 7 of [7], gave an expression of the frequency related to IFR-K', which moves at velocity *v* parallel to c, which is

$$\nu' = \frac{\nu_0(c+v)}{c.\left(1-\frac{v^2}{c^2}\right)^{1/2}}; \qquad (2\text{-}14)$$

Einstein did not give the length of the wave λ', which, when taking DE into consideration here, is

$$\lambda' = \lambda_0 \left(1 - \frac{v^2}{c^2}\right)^{1/2}; \qquad (2\text{-}15)$$

If λ' was given, the immediate result would be

$$c = \nu'.\lambda' = \nu_0.\lambda_0.\frac{(c+v)}{c} = \frac{c}{c}(c+v) = c + v \neq c \neq const.; \qquad (2\text{-}16)$$

I. e. by taking DE into account in STR, Einstein himself denied PCSL.

But since λ was not given in [7], no one STR interpreters added it, probably out of respect for Einstein, and that is why the denial (2-16) of PCSL was not arrived at.

Emphasis*. It is incomprehensible how it is possible the same article [7] to defend PCSL at the beginning, and in paragraph 7 to deduce DE, which denies PCSL.*

Here the circumstance why the length of the wave λ' (2-15) was not given in [7], awakes suspicion, since from it we can easily ascertain that DE denies PCSL by an experimentally validated fact. Moreover, these facts have not been noticed by experts in the field of STR since 1905 until today. But from the viewpoint of the requirements of PCSL, according to (2-6), the frequency ν' (2-14) and the length of the wave λ, are reduced to

$$\text{a) } \nu' = \nu_0 \frac{c}{c.1} = \nu_0; \text{ b) } \lambda = \lambda_0.1; \qquad (2\text{-}17)$$

since the term in the nominator of (2-14) when replacing PCSL (2-6) is

$$\left(1 - \frac{v^2}{c^2}\right)^{1/2} = \left[\frac{\left(c^2 - v^2\right)}{c^2}\right]^{1/2} = \left[\frac{(c-v)(c+v)}{c^2}\right]^{1/2} = \left[\frac{c.c}{c^2}\right]^{1/2} = 1; \qquad (2\text{-}18)$$

Third. *LT are implicit form of*

From (2-18) it is evident that the nominator of LT is equal to one.

When applying notation (2-6) and (2-2) of PCSL to the numerators of the terms x' and t' from the notation (2-3) of LT, we obtain the following data

$$x' = x - v.t = c.t - v.t = (c-v)t = c.t; \qquad (2\text{-}19)$$

$$t' = \frac{c^2 t - v.x}{c^2} = \frac{c^2.t - v.c.t}{c^2} = \frac{(c-v)c.t}{c^2} = \frac{c^2}{c^2}.t = t; \qquad (2\text{-}20)$$

i. e. *the times in both IFR-K and IFR- K' are the same*. Therefore on applying PCSL to LT, whereby (2-3) are reduced to

$$\text{a) } x' = c.t; \text{ b) } y' = y:c; \text{ c) } z' = z; \text{ d) } t' = t; \qquad (2\text{-}21)$$

Or the velocities of light in both systems, according to PCSL, are identical, i. e. **another variant of the notation of PCSL is obtained,** which is given by (2-2)e, i. e.

$$\text{a) } \frac{x'}{t'} = \frac{x}{t} = c \text{; or as Einstein in [15], § 11 b) } x' = ct'; \text{и } c)\, x = ct; \qquad (2\text{-}22)$$

Inferences from the presented in point three

1. **LT are incompatible to Galileo's principle of relativity;**
2. **LT, as well as PCSL, are unreal assumptions in TR.**

Fourth. On applying PCSL according to (2-18), it follows that the dependence of

the mass on the velocity v according to STR through LT is

$$m = m_0.\left(1-\frac{v^2}{c^2}\right)^{-1/2} = m_0.1 = m_0 = const.; \qquad (2\text{-}23)$$

But the actual value of m is obtainable through Maxwell's theory only (see Chapter One, paragraph (1.3.2).

Fifth. From the application of (2-18), it follows that the deduction of the kinetic energy is zero

$$W_k = w_0\left[\left(1-\frac{v^2}{c^2}\right)^{-1/2} - 1\right] = m_0.c^2\left[1-1\right] = m_0.c.0 = 0; \qquad (2\text{-}24)$$

It turns out that when applying PCSL (2-6) there is no kinetic energy, although it does exist and can be obtained by applying Maxwell's theory only.

Sixth. TR, based on LT, claims that the length L_0 of bodies shortens, and the duration of time T_0 extends for an observer, who moves at velocity $v \neq 0$, i. e.:

$$\text{a) } L = L_0\left(1-\frac{v^2}{c^2}\right)^{1/2}; \text{ b) } T = T_0\left(1-\frac{v^2}{c^2}\right)^{-1/2}; \qquad (2\text{-}25)$$

Einstein in [8] writes: „Time cannot be considered as something absolute, i. e. something that does not depend on the state of the frame of reference, and the geometric dimensions of bodies cannot be considered independent of the state of the frame of reference, related to which they are measured." Einstein in [9] writes: *"The shortening is not real, as long as it relates to an observer, who moves along with the body; but it is real, because, in principle, it can be proved by physical means for an observer who does not move along with the body."*

But according to (2-18), it follows that (2-25) is reduced to

$$\text{a) } L = L_0.1 = L_0; \text{ b) } T = T_0.1 = T_0; \qquad (2\text{-}27)$$

i. e. there is no changes in the length L_0 or the time T_0.

Seventh. When determining the concurrence in paragraph 2 of [7] instead of

$$\text{a) } t_B - t_A = \frac{r_{AB}}{c - v}; \text{ b) } t'_A - t_B = \frac{r_{AB}}{c + v}; \qquad (2\text{-}27)$$

according to (2-6), it should be obtained

$$t_B - t_A = \frac{r_{AB}}{c} = t'_A - t_B = \frac{r_{AB}}{c} \rightarrow t_B - t_A = t'_A - t_B; \qquad (2\text{-}28)$$

whence another interpretation of the notion of concurrence follows, **namely, that it does not depend on the velocity of the inertial system,** *since r_{AB} is the length of the distance (of the moving rod) in the inertial system at rest,* **which is constant.**

Eighth. There is no space-time continuum - STC

Using the notation of PCSL according to (2-6) via the coordinates x and r, the notation of STC is given in two inertial coordinate systems IFR-K and IFR-K', as follows

$$\text{a) } x = c.t; \; x' = c.t'; \text{ b) } r = c.t; \; r' = c.t'; \qquad (2\text{-}29)$$

where the times t and t' are determined by LT.

After the velocity c from (2-29) is eliminated, the notation of STC is obtained according to H. Minkowski, which notation is used by Einstein, too, in STR:

$$\text{a) } x = x'.\frac{t}{t'}\text{; b) } r = r'.\frac{t}{t'}; \qquad (2\text{-}30)$$

But this proof, in point three eq. (2-20) and (2-21), when applying the notation of PCSL to LT, it becomes evident that the times t and t', in two inertial systems K and K' are equal, i. e. $t = t'$.

It follows that x and r from (2-30) are reduced to

$$\text{a) } x = x'.\frac{t}{t'} = x'\text{; b) } r = r'.\frac{t}{t'} = r'; \qquad (2\text{-}31)$$

Id est STC drops off from TR and especially from STR.

2.1.2. Emphasis. In the presented about STR, according to [7], one of the most impressing circumstance is that at first Einstein worded the definition of PCSL as follows: "The sum of the velocity of light *c* and the velocity *v*, which is smaller than c (*v* < *c*) is always equal only to c , which notated mathematically for PCSL is

$$u_c = c \pm v = c = const.; \qquad (2\text{-}6)$$

In the description of STR and LT, despite the citations in (2-6) from I to VI, PCSL is not observed, respectively (2-6) or (2-2). The deduced regularities are written by the term $(c \pm v) \neq c$, not by its reduced form c, according to (2-6).

From the presented, arises the question why Einstein and the supporters of TR have not noticed this incongruence between the description of the regularities of STR and LT and the written about PCSL, ***why PCSL is essentially not used in the description either of STR or LT****.*

3. Conclusion on STR

1. *In spite of its flaws STR has played some positive role in the advancement of physics.*

2. *But since its reliable (experimentally validated) results were proved by Maxwell's theory – a simpler theory preceding it in time (1873), STR should drop out of the list of real physical theories and remain only a history.*

3. Section two. General theory of relativity - GTR

3.1. GTR overview

In [10] Einstein writes: *"The general theory of relativity is still incomplete in the sense that the general principle of relativity can be applied satisfactorily only to the gravitational field, but not to all the fields."*

In [11] Einstein writes: "… so that the fundament of GTR is completed, it is necessary to introduce into it the electromagnetic field as well."

In [12] Einstein, about (3-1), writes: "The contents of the general theory of

relativity are formally described by the equation:

$$R_{ik} - \frac{1}{2} g_{ik}.R = \chi.T_{ik} ; \qquad (3\text{-}1)$$

where: R_{ik} is Ricci tensor; R - invariant of R_{ik}, χ - coefficient of proportionality and T_{ik} - tensor of the energy."

In [12] Einstein writes: "The second term of the left part is added because of formal reasons, namely: the left part is written so that its divergence … be equal to zero. The right part includes everything that cannot be united in the unitary theory of field. *Naturally, I do not have the slightest doubt that such a formulation is only a temporary solution, taken in order to create a complete description of the general principle of relativity.* This formulation in essence is nothing else but a theory of gravitation, which somehow artificially has been exempt from the unitary field of unknown structure."

From the contents of the above citations of Einstein, and by adding the citation about eq. (3-1) of Einstein from [13], which states:

"the equation of the field (he meant (3-1) – P. P.'s note) introduced by us earlier without a cosmological term is ad hoc", it is evident that eq. (3-1) **is not a result of a theoretical deduction, but was simply written to express his own ideas without any experimental validation**.

Because of the last fact, we do not make an analysis, but simply make a reference to the written above, which is a text by Einstein about eq. (3-1), saying that there is no GTR, but only a formulation of the theory of gravitation, for which no algorithm was described for the metrics in Riemannian geometry, not was it specified for what cosmic structure it referred (3-1).

3.1.1. On the principle of equivalence - PE in GTR

According to the law of gravitational field $\vec{G}$, the fields $\vec{G}_A$ and $\vec{G}_B$ at distance $0 < \Delta r_{AB} << 1$ in the points A and B, on an equipotential gravitational surface with radius R_0, are at angle

$$\alpha_{AB} \approx \sin \alpha_{AB} = \frac{\Delta r_{AB}}{R_0} > 0 ; \qquad (3\text{-}2)$$

Id est always the angle $\alpha_{AB} > 0$, *because of which* $\vec{G}_A$ *and* $\vec{G}_B$ *are never parallel, because of which there is never an uniform gravitational field, which is the motivated of the principle of equivalency.* **That is why there is not and cannot be a real principle of equivalence - PE.**

4. Summarized conclusion on TR

For the time being, there is no developed and experimentally validated TR and according to the requirements of physics on a scientific physical theory, TR does not really exist.

Literature

1. A. Einstein. Fundamentals of General Theory of Relativity. CSW v. I (p. 452). Nauka, M. 1965 (in Russian). Translated from German: A. Einstein. Die Grundlage der Allgemeinen Relativitätstheorie. Ann. Phys. 1916, 49. 769-822.

2. A. Einstein. Theory of relativity. CSW v. I (p. 410). Nauka, M. 1965 (in Russian) Translated from German: A. Einstein. Relativitätstheorie, from the book: Die Physik. Unter Redaktion von E. Lechner. t. 3. Abt. 3. Bd.l. Leipzig. Teubnez. 1915. 703-713.

3. A. Einstein. What is the theory of relativity? CSW. v. I (p. 677). Nauka, M. 1965 (in Russian) Translated from: A. Einstein. What is the theory of relativity? From the book: ldeas and Opinions" N. Y. Grown Publishers Inc., 1954.

4. A. Einstein. On the principle of relativity. CSW. v. I (p. 395). Nauka M. 1965 (in Russian) Translated from: A. Einstein. Vom Relativitäts - Prinzip. Vossische Zeitung. 1914. 26. April. 33, 34.

5. A. Einstein. On the principle of relativity and its consequences. CSW. v. I (p. 65). Nauka, M. 1965. (in Russian) Translated from: A. Einstein. über das Relativitätsprinzip und die denselben gezogenen Folgerungen Jharb. d. Radioaktivität u. Elektronik. 1907. 4, 41 1-462.

6. A. Einstein and L. Infeld. Evolution of physics. Article in CSW v. IV p. 357. Nauka, M. 1967(in Russian)

7. A. Einstein. On the electrodynamics of moving bodies. CSW. v. I (p. 7). Nauka, M. 1965 (in Russian) Translated from: A. Einstein. Zur Elektrodinamik der bewegtes Körper. Ann. Phys. 1905, 17, 891-921.

8. A. Einstein. Theory of Relativity. SNT, Vol. I, p. 175, Nauka, Moscow, 1965 (in Russian). (Translated from: A. Einstein. Die U Relativitätstheorie. Naturforsch. Geselschaft, Viertel-Jahresschrift. 1 Zurich, Jahrg. 1911, 56, S. 1-14.)

9. A. Einstein. Autobiographical notes. CSW v. IV (p. 259). Nauka, M. 1967 (in Russian) Translated from: A. Einstein. Autobiographisches. From the book: „Albert Einstein - Philosopher -Scientist", edited by P. A. Schlipp. Evanston (Illinois) 1945, 1-95

10. A. Einstein. Relativity: Essence of the Theory of Relativity. CSW. II. (p. 657). Nauka, M. 1966 (in Russian) Translated from: A. Einstein. Relativity: Essence of the Theory of Relativity. Amez. People Encycl., 1949. XVI, Chicago.

11. A. Einstein. The Unitary theory of physical filed. CSW v. II (p. 286). Nauka, M. 1966 (in Russian) Translated from French: A. Einstein. Theorie unitaire de shamp physiquue. Ann. Inst. H. Poincare, 1930, 1, 1-24.

12. A. Einstein. Generalisation of Theory of Gravitation. CSW v. II (p. 762). Nauka, M. 1966 (in Russian) Translated from A. Einstein. Generalisation of Theory of Gravitation. The Meaning of Relativity, fourth edition. Prison. 1053.

13. A. Einstein. On the theory of relativity, CSW. v. II, (p. 109), Nauka, M. 1966 (in Russian)

14. A. Einstein. Fundamental ideas and problems of the theory of relativity. CSW. v. II. (p. 120). Nauka, M. 1966 (in Russian) Translated from: A. Einstein. Grundgedanken und Probleme der Relativitätsthene. From the book: „Nobelstiftelsen, Les Prix Nobelen 1921-1922". Imprimerie Royale. Stocholm.1923.

15. A. Einstein. On the special and general theory of relativity. CSW. v. I (p. 531). Nauka, M., 1965 Translated from A. Einstein. Über die specielle und Algemeine Relativitätstheorie (Geomeinsamverständlich). Drück und Verlag von Friedr. Viwege Sohn. Braunschweig. 1920.

16. A. Einstein. On the Cosmologic problem. CSW. v. II (p. 597). Nauka, M. 1966 (in Russian) Translated from A. Einstein. On the Cosmologic problem. The Meaning of Relativity, 2nd Edition, Priston, 1945.

17. A. Einstein. Fundamentals of the general theory of relativity. CSW v. I (p. 452). Nauka, M. 1965 (in Russian) Translated from A. Einstein. Die Grundlage der Allgemeinen Relativitätstheorie. Ann. Phys. 1916, 49. 769-882.

18. A. Einstein. Relativity and gravitation. CSW. v. I. (p. 217). (in Russian) Translated from A. Einstein. Relativität. und Gravitation „Ervidaruny auf eine Bemerkung von M. Abracham Ann. Phys. 1912. 38, 1956-1958.

3. Supplement III
Flaws in quantum mechanics

General notes

It was N. Bohr who first used the phrase of **quantum mechanics** in 1915 but, in essence, as a general form of the quantum mechanics are treated the facts concerning:

1) Max Planck's theory on the radiation of the photon, which was associated with Planck's constant-h of 1900 and with the preceding Stefan - Boltzmann law

2) N. Bohr's model of atom

3) De Broglie's waves

4) Schrödinger's equation

Part I
On N. Bohr's postulates

1. On the angular momentum Lo of the electron in the atom, when it absorbs and emits photons

In a closed system, such as is the electron in the atom, without any influence from external fields, the electron is attracted by the electric field of the nucleus $\vec{E}_{\text{я}}$ by the centripetal force

$$\vec{F}_{\text{e}} = q_{\text{e}}.\vec{E}_{\text{я}} = -\frac{q_{\text{e}}.q_{\text{я}}.\vec{r}_0}{4\pi\varepsilon_0.r^2} = -\frac{\beta}{r^2};\ \beta = \frac{q_{\text{e}}.q_{\text{я}}}{4\pi\varepsilon_0}; \qquad (1\text{-}1)$$

For an electron to retain a stable orbit at distance $r = r_0$ it is necessary that its velocity $\vec{v}_0$ be perpendicular to force $\vec{F}_{\text{e}}$ (1-1), **since then the force does not release energy to the electron, i. e.**

$$dW = \vec{F}_{\text{e}}.d\vec{r} = \vec{F}_{\text{e}}.\vec{v}_0.dt.\cos\pi/2 = 0, \qquad (1\text{-}2)$$

but only changes the direction of the velocity along the orbital which is a circle.

The kinetic W_{k0} and the potential W_{p0} energies of the electron along an orbital with radius r_0 are

$$\text{a)}\ W_{\text{k0}} = \frac{m_{\text{e0}}.v_0^2}{2};\ \text{b)}\ W_{p0} = +\frac{\alpha}{r_0}; \qquad (1\text{-}3)$$

The full energy of the electron is

$$W_0 = W_{k0} + W_{p0} = \frac{m_{e0}.v_0^2}{2} + \frac{\alpha}{r_0}; \qquad (1\text{-}4)$$

The angular momentum of the electron, which has a dimensionality Joule by second *[J.s] is equal to* the dimensionality of Planck's constant-h, and is

$$\vec{L}_0 = [\vec{r}_0.\vec{p}_0] = m_{e0}[\vec{r}_0.\vec{v}_0] = K_L = const.; \quad (1\text{-}5)$$

The derivative of L_0 related to the time is

$$\text{a)}\ \frac{d\vec{L}_0}{dt} = [\vec{r}_0.\vec{F}_e] = M = 0;\ \text{b)}\ \vec{F}_e = \frac{d\vec{P}_e}{dt} = \frac{d(m_{e0}.\vec{v}_0)}{dt} = -\frac{\alpha}{r_0^2}; \quad (1\text{-}6)$$

since in this case $\vec{r}_0$ and $\vec{F}_e$ are perpendicular.

Since there is no external influence

$$\text{a)}\ W_{k0} = const.;\ \text{b)}\ W_{p0} = const.; \rightarrow \text{c)}\ M = 0;\ \text{d)}\ L_0 = const.; \quad (1\text{-}7)$$

Two cases are possible, which may violate (1-7)

Case A. If the electron absorbs one photon from the outside (a quantity of electromagnetic energy), which is the kinetic energy W_f, its kinetic energy increases to

$$W_K^{-1} = W_{K0} + W_f = \frac{m_{e0}.v_0^2}{2} + W_f = \frac{m_{e0}.v^2}{2} > W_{K0}; \quad (1\text{-}8)$$

I. e. the velocity v^2 after the absorption of the photon is

$$v'^2 = v_0^2 + \frac{2.W_f}{m_{e0}} > v_0^2; \quad (1\text{-}9)$$

Since the full energy (1-4) is constant, it follows that the potential energy of the electron should change to

$$W_p^{-1} = W_{P0} + W_f = -\frac{\alpha}{r_0} + W_f = -\frac{\alpha}{r'}; \quad (1\text{-}10)$$

Or the radius will increase to

$$r' = r_0\left(\frac{\alpha}{\alpha - W_f.r_0}\right) > r_0; \quad (1\text{-}11)$$

I. e. in absorption of a photon, the electron, according to the classical theory, moves to a higher orbital.

Along with that, the angular momentum increases to

$$\vec{L} = [\vec{r}'.\vec{p}'] = m_{e0}.[\vec{r}'.\vec{v}'] > \vec{L}_0; \quad (1\text{-}12)$$

Regardless of the classical approach, here (case A) a new quantity of kinetic energy W_f is added and that is why the angular momentum at such processes is not constant (const.) as it is in classical bodies, in which their kinetic energy is constant; therefore $L = const.$, too. **I. e. it follows from the general definition of *L* that when the kinetic energy of the body c changes, it follows that**

$$\text{I. At a)}\ W_K = const.; \rightarrow \text{b)}\ L = const.; \quad (1\text{-}13)$$

$$\textbf{II. At a)}\ W_K \neq const.\textbf{;} \rightarrow \textbf{b)}\ L \neq const.\textbf{;} \quad \textbf{(1-14)}$$

Case B. If the electron emits a photon with kinetic energy W_f, then its kinetic energy decreases to

$$W_K'' = W_{K0} - W_f = \frac{m_{e0}.v_0^2}{2} - W_f = \frac{m_{e0}.v''^2}{2} < W_{K0}; \quad (1\text{-}15)$$

I. e. after the emission of the photon, the velocity of the electron is

$$v''^2 = v_0^2 - \frac{2.W_f}{m_{e0}} < v_0^2 ; \qquad (1\text{-}16)$$

Since W_0 (1-4) is constant, the potential energy of the electron changes from W_{p0} to

$$W_p'' = W_{P0} + W_f = -\left(\frac{\alpha}{r_0} + W_f\right) = -\frac{\alpha}{r''} ; \qquad (1\text{-}17)$$

or the radius of the electron decreases to

$$r'' = r_0\left(\frac{\alpha}{\alpha + W_f.r_0}\right) < r_0 ; \qquad (1\text{-}18)$$

I. e. in emission of a photon, the electron, according to the classical theory, moves to a lower orbital.

$$\vec{L}'' = \left[\vec{r}''.\vec{p}''\right] = m_{e0}.\left[\vec{r}''.\vec{v}''\right] < L_0 ; \qquad (1\text{-}19)$$

From the presented above, a new law is defined about the classical electrodynamics and mechanics, which states: **With the change of the kinetic energy of the body (electric charge), the angular momentum of the body changes as well, i. e. the angular momentum, at variable kinetic energy of the body, is variable – it is not constant.**

2. On the wave energy for time $\tau = n.T = \frac{n}{\nu}$

Here we start from the formula of the energy of a photon with frequency $\nu = \frac{1}{T}$ is equal to

a) $W_f = h.\nu = \frac{h}{T} \rightarrow$ = *constant by frequency*; b) $T.\nu = 1$; (2-1)

So far, the dependence (2-1) has been considered to be unique related to the mechanical and electromagnetic waves.

But a passing glance over the mechanical elastic wave processes, where the density of the wave energy for one period T is

$$w = \frac{\rho.A.\omega^2}{2} = \frac{\rho.A.4\pi^2.\nu^2}{2} ; \qquad (2\text{-}2)$$

where: ρ is the density of the deformed mass; A – the amplitude; $\omega = 2\pi\nu$ - the angular frequency; $\nu = 1/T$ - the frequency

For time $\tau = n.T = \frac{n}{\nu}$ the emitted wave energy, where $n = 1, 2\ldots$, n - integer, is

$$W_\tau = w.\tau = w.n.T = w.\frac{n}{\nu} = \rho.A.2\pi^2.\nu = H.\nu ; \qquad (2\text{-}3)$$

Where H is constant for this wave process and is

$$H = \rho.A.2.\pi^2 = const.; \quad (2\text{-}4)$$

In this sense, Chapter One and §17 shows that the energies W of all wave processes is described by the following law.

Wave energy for time $\tau = nT =$ *constant by frequency* (2.1) with the atom, since the constructive system of the transmitter (the atom) is the same – a nucleus and electrons in orbitals, where the parameters change only in quantitative respect, and the constant $H = h$ retains its value regardless of the quantitative change of the charge of the nucleus or the number of the electrons or their distance to the nucleus.

Therefore, the formula (2-1) is not unique only for the atom as a transmitter of photons, but this fact allows us to argue that the theory of emission of the atom is only a specific case with specificities of the transmitter. But this process of emission obeys the classical law of emission of electric charge from the classical Maxwell's electrodynamics, which, for the power N emitted by charge q_e, which moves at acceleration a_e. is

$$\frac{dW}{dt} = N = \frac{\mu_0.q_e^2.a_e^2}{6.\pi.c}; \quad (2\text{-}5)$$

Where the time of emission τ of one photon and the number of the oscillations n are

$$\text{a) } \tau = \frac{12.\pi.c.m}{\mu_0.\omega^2.q_e^2}; \text{ b) } n = \frac{6.c.m}{\mu_0.\omega.q_e}; \quad (2\text{-}6)$$

For example, for frequencies of the visible light $\nu \sim 4.10^{15}\,Hz$

$$\text{a) } \tau \sim 10^{-8}\,s; \text{ b) } n \sim 10^7\,oscillations; \quad (2\text{-}7)$$

From the summary of the presented above is formed the classical law of the emitted wave energy, which states: *The emitted wave energy W_f for time $\tau = n.T = n/\nu$, i. e. for time τ, which is n times the time of one period T of the monochromatic wave ($T.\nu = 1$) is equal to the product of one constant H by the dimensionality [J.s] – Joule by second, by the frequency ν of the wave process, i. e.*

$$W_\nu = H.\nu; \quad (2\text{-}8)$$

3. The model of the classical mechanism of emission and absorption of photons of the atoms

3.1. Initial conditions

3.1.1. The simplest atomic structure of the hydrogen atom is used as a model in the analysis. The hydrogen atom has the main features of emission of electromagnetic waves, in the form of photons; such are in all atoms, although the other electrons exert influence in them.

Here the electric charges of the nucleus - $q_я$ and of the electron q_e have equal values and opposite signs ($|q_я| = |q_e|$).

We proceed from the electromagnetic laws. *First.* When an electric charge (q_e) moves, a magnetic field (H) in induced around it proportional to its velocity (v), and the magnetic energy (W_H) is proportionate to the square of H and of v ($W_H \equiv H^2 \equiv v^2$). *Second.* When an electric charge moves at acceleration ($\vec{a}$), it emits electromagnetic energy (wave) with power N, which is proportionate to the square of $\vec{a}\left(N \equiv a^2\right)$.

The electron moves in a circular orbit with radius r and n revolutions per second at velocity

a) $v = 2.\pi.n.r$; b) $r = \dfrac{v}{2.\pi.n}$; (3-1)

3.1.2. In this model, the electron is characterized by:

3.1.2.1. The electric field $\vec{E}_e$ with density of the electrostatic energy w_e, the electrostatic energy W_E and mass m_{e0} at rest of the electron.

a) $\vec{E}_e = \dfrac{q_e.\vec{r}_0}{4\pi\varepsilon_0 r^2}$; b) $w_E = \dfrac{\varepsilon_0.E_e^2}{2} = \dfrac{q_e^2}{2.\varepsilon_0\left(4\pi r^2\right)^2}$; (3-2)

a) $W_E = \int_{r_{e0}}^{\infty} w_e.dV = \int_{r_{e0}}^{\infty} w_e.4\pi r^2 dr = \dfrac{q_e^2}{4\pi\varepsilon_0.r_{e0}} = q_e^2.k_e$; b) $k_e = \left(4\pi\varepsilon_0.r_{e0}\right)^{-1}$; (3-3)

a) $m_{e0} = \dfrac{W_E}{c^2} = q_e^2.k_m$; b) $k_m = \left(4\pi\varepsilon_0.r_{e0}.c^2\right)^{-1}$; (3-4)

3.1.2.2. Magnetic field $\vec{H}_0$, density of the magnetic energy w_H and the magnetic energy of the electron W_{He} are

a) $\vec{H} = \varepsilon\left[\vec{v}.\vec{E}_e\right] = \dfrac{q_e.v\vec{i}}{4\pi r^2}$; b) $\vec{i} = \left[\vec{v}_0.\vec{r}_0\right]$; c) $\vec{v}_0.\dfrac{\vec{v}}{|\vec{v}|}$; (3-5)

This law is also experimentally validated for the electrons in the atoms of wires through which runs electric current, which is a flux of electric charges (electrons from the atoms of the electric wire or electronic flux at the transmitter of electrons), independently of their treatment as de Broglie's waves in quantum mechanics.

$w_H = \dfrac{\mu_0.H^2}{2} = \dfrac{\mu_0.q_e^2v^2}{2\left(2\pi r^2\right)^2} = \dfrac{q_e^2v^2}{2\left(4\pi r^2\right)^2.\varepsilon_0.c^2}$; b) $\mu_0 = \dfrac{1}{\varepsilon_0.c^2}$; (3-6)

$W_{HE} = \int_{r_{e0}}^{\infty} w_H.dV = \dfrac{q_e^2.v^2}{8\pi\varepsilon_0.c^2}.\int_{r_{e0}}^{\infty}\dfrac{dr}{r^2} = \dfrac{q_e^2.v^2}{4\pi\varepsilon_0.r_{e0}.c^2.2} = \dfrac{m_{e0}.v^2}{2}$; (3-7)

where: μ_0 is the magnetic constant of the vacuum; r_{e0} - the computational radius of the electron.

3.1.2.3. In the electric field of the nucleus $\vec{E}_{я}$, which generates attractive force of the electrons toward the nucleus, which is the centripetal force, is

$$\vec{F}_{\mathrm{c}} = q_{\mathrm{e}}.\vec{E}_{\mathrm{s}} = \frac{q_{\mathrm{e}}^2.\vec{r}_0}{4\pi\varepsilon_0.r^2} = \frac{q_{\mathrm{e}}^2.\vec{r}_0}{4\pi\varepsilon_0.r^2}\cdot\frac{r_{\mathrm{e}0}.c^2}{r_{\mathrm{e}0}.c^2} = m_{\mathrm{e}0}.\vec{a}_{\mathrm{c}} = mass\ x\ of\ acceleration$$

; $\vec{r}_0 = \frac{\vec{r}}{|\vec{r}|}$; (3-8)

a) $m_{\mathrm{e}0} = \frac{W_{\mathrm{E}}}{\mathrm{c}^2} = \frac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0.r_{\mathrm{e}0}.c^2}$; b) $\vec{a}_{\mathrm{c}} = \frac{v^2}{r} = (2\pi n)^2.\vec{r} = \frac{r_{\mathrm{e}0}.c^2.\vec{r}_0}{\mathrm{r}^2} = \frac{\vec{F}_{\mathrm{c}}}{\mathrm{m}_{\mathrm{e}0}}; \rightarrow \left[m.s^{-2}\right];$ (3-9)

where: m_{e0} is the mass of the electron: $\vec{a}_c$ - centripetal acceleration of the mass of the electron, which moves at velocity *v* along circular orbital; r_{e0} - the classical radius of the electron; *c* - the velocity of electromagnetic waves (light) in vacuum; ε_0 - the dielectric constant of the vacuum.

4. Emission of photons according to the classical electrodynamics

For the purposes of the analysis, because of the relatively small differences between the radiuses *r* and the revolutions *n* of the orbitals *i* and *k*, it is assumed that they are constant, since this condition will not alter the essence of the inferences. In radial movement of the electron at acceleration $\vec{a}_{\mathrm{c}}$ from the orbital with radius $r_{\mathrm{k}} < r_i$ to a lower orbital with radius along distance $d\vec{r}$, its magnetic energy decreases by

$$dW_{\mathrm{r}} = \vec{F}_{\mathrm{c}}.d\vec{r} = m_{\mathrm{e}0}(2\pi n)^2.\vec{r}.d\vec{r} = \frac{q_{\mathrm{e}}^2.\vec{r}.d\vec{r}}{4\pi\varepsilon_0.r^2};$$ (4-1)

Or since after the movement at $d\vec{r}$ to an orbit of a smaller radius $r' = r - dr$ and lower velocity $v' = (2\pi n)^2.r' \langle v = (2\pi n)^2.r$ with taking into account (3-1), it follows that (4-1) can be written in the form

$$dW_r = m_{\mathrm{e}0}(2\pi n)^2.\vec{r}.d\vec{r} = m_{\mathrm{e}0}(2\pi n)^2\frac{\vec{v}d\vec{v}}{(2\pi n)^2} = m_{\mathrm{e}0}\vec{v}d\vec{v};$$ (4-2)

This decrease of the magnetic energy of the electron is a result of the electromagnetic theory that during accelerated motion, the electric charge emits electromagnetic energy in the form of electromagnetic waves (photons).

The emitted electromagnetic energy of the electron during its motion along the orbital with radius r_{i} to the orbital with radius $r_k < r_i$ e:

$$W_{\mathrm{rik}} = \int_{\mathrm{r_i}}^{r_{\mathrm{k}}} \mathrm{dW_r} = -\frac{m_{\mathrm{e}0}}{2}(2\pi n)^2\left(r_{\mathrm{i}}^2 - r_{\mathrm{k}}^2\right) = -\frac{m_{\mathrm{e}0}}{2}\left(v_{\mathrm{i}}^2 - v_{\mathrm{k}}^2\right) = W_{\mathrm{ri}} - W_{\mathrm{rk}} = W_{\mathrm{f}};$$ (4-3)

This electromagnetic energy is electroenergy momentum, called photon with energies $W_{\mathrm{f}} = W_{\mathrm{rik}}$, mass m_f and momentum $\vec{p}_{\mathrm{f}}$.

$$\text{a) } W_{\mathrm{f}} = W_{\mathrm{rik}} = h.\nu \text{ ; b) } m_{\mathrm{f}} = \frac{W_{\mathrm{f}}}{\mathrm{c}^2} \text{ ; c) } \vec{p}_{\mathrm{f}} = m_{\mathrm{f}}.\vec{c} = \frac{W_{\mathrm{f}}}{\mathrm{c}}\vec{c}_0 \text{ ; } \vec{c}_0 = \frac{\vec{c}}{|\vec{c}|} \text{ ;} \qquad (4\text{-}4)$$

or proceeding from the last part of (4-1) and by replacing

$$\text{a) } r_{\mathrm{i}} = \mathrm{r}_0 n_{\mathrm{i}}^2 \text{ ; b) } r_{\mathrm{k}} = \mathrm{r}_0 n_{\mathrm{k}}^2 \text{ ; c) } n_{\mathrm{i}} = 1, 2, \ldots \text{ ; } n_{\mathrm{k}} \neq n_i.1, 2, 3, \ldots \text{ ;} \qquad (4\text{-}5)$$

and by applying the classical electrodynamics law (2-8) in (4-3) for W_{rik} , the result is

$$W_{\mathrm{rik}} = \int_{\mathrm{r_i}}^{r_{\mathrm{k}}} \mathrm{dW_r} = \frac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0}\left(\frac{1}{r_{\mathrm{k}}} - \frac{1}{r_{\mathrm{i}}}\right) = \frac{q_{\mathrm{e}}^2}{4\pi\varepsilon_0 r_0}\left(\frac{1}{n_{\mathrm{k}}^2} - \frac{1}{n_{\mathrm{i}}^2}\right) = h.\nu \text{ ;} \qquad (4\text{-}6)$$

Π With taking into account the experimental law, known even before 1890, about the frequency of the photon through the constant of Rydberg R

$$\text{a) } \nu = \frac{R}{r_0}\left(\frac{1}{n_k^2} - \frac{1}{n_{\mathrm{i}}^2}\right) \text{ ; } \rightarrow \text{ b) } \frac{\nu}{R} = \frac{1}{r_0}\left(\frac{1}{n_k^2} - \frac{1}{n_{\mathrm{i}}^2}\right) = h.\nu \text{ ;} \qquad (4\text{-}7)$$

from (4-6), it follows that Planck's constant is

$$h = q_{\mathrm{e}}^2\left(4\pi\varepsilon_0 r_0 R\right)^{-1} = const. \text{ ;} \qquad (4\text{-}8)$$

These inferences follow from the description of J. C. Maxwell in 1890 in paragraph 638 of „Treatise on electricity and magnetism", *where he writes:* **„We must consider both magnetic and electromagnetic energies as kinetic energies."**

In paragraph 636 Maxwell writes: „… the kinetic energy is available wherever there is magnetic force, i. e. it is in all parts of the magnetic field…"... „The only question is where it is located. According to our theory, it is located in the electromagnetic field in space which surrounds the electrified and the magnetized bodies, as well as inside the bodies. And it is manifested in two different forms of magnetic and electric polarization".

5. Absorption of photons according to the classical electrodynamics

If an electron from an atom with mass m_{e0} and velocity v_0 absorbs a photon with energy $W_{\mathrm{f}} = h.\nu$, then the magnetic (the kinetic) energy W_{ri} of the electron increases by the energy of the photon W_f and becomes

$$W_{\mathrm{ik}} = W_{\mathrm{ri}} + W_{\mathrm{f}} = \frac{m_{\mathrm{e0}}.v_{\mathrm{c}}^2}{2} + W_{\mathrm{f}} = \frac{m_{\mathrm{e0}}.v_{\mathrm{k}}^2}{2} > W_{\mathrm{ri}} \text{ ;} \qquad (5\text{-}1)$$

where:

$$\text{a) } v_{\mathrm{k}}^2 = v_0 + \frac{2W_{\mathrm{f}}}{\mathrm{m_{e0}}} = \left(v_0 + \Delta v_{\mathrm{f}}\right)^2 - 2.\Delta v_{\mathrm{f}}.v_0 \text{ ; b) } \Delta v_{\mathrm{f}} = \left(2\frac{W_{\mathrm{f}}}{\mathrm{m_{e0}}}\right)^{\frac{1}{2}} \text{ ;} \qquad (5\text{-}2)$$

or

$$v_{\mathrm{k}} = v_0 + \Delta v_{\mathrm{f}} = v_0 + \left(2\frac{W_{\mathrm{f}}}{\mathrm{m_{e0}}}\right)^{\frac{1}{2}} \text{ ;} \qquad (5\text{-}3)$$

and

$$W_{ik} = \frac{m_{e0}}{2}\left(v_0 + \Delta v_f\right)^2 - m_{e0}.\Delta v_f.v_0 = \frac{m_{e0}.v_k^2}{2} > W_{ri}; \qquad (5\text{-}4)$$

6. Emphasis

6.1. Paragraphs 4 and 5 illustrate and motivate the fact that the atoms (molecules), when they absorb a photon through their valent electrons, their magnetic (kinetic) energy increases. Here it is essential to note that the velocities of the electrons in the atoms and the molecules $v_c << c$ are much smaller than the velocity of the electromagnetic waves (light) in the vacuum. That is why the computations are made at constant masses $m_{e0} = const.$ of the electrons and with kinetic energy according to Newton.

6.2. These processes are governed by regularities of the classical electrodynamics motivated in this study, as follows

6.2.1. ***The kinetic energy is magnetic energy, or al forms of manifestation of the kinetic energies are electromagnetic energies.***

6.2.2. ***The kinetic energy is transported from one object to another in the form of electromagnetic waves (photons).***

6.3. Interpretations of the consequences from the laws 6.2.1 and 6.2.2

6.3.1. The idea that the kinetic energy is magnetic and part of it is converted as photons explains the unity (homogeneity of the kinetic with photon energy (homogeneity) of the cause (the mechanical kinetic energy) and result (the electromagnetic energy of the photon) and vice versa). And the fact that the electromagnetic theory of Maxwell holds true for the atom too, namely, that the change in the time of the magnetic flux generates electric field, and the change of the electric flux generates a magnetic field. I. e. the change of the two fluxs is a law proceeding from the theory of Maxwell – classical physics.

6.3.2. The emission and absorption of photons by the atoms and the molecules is according to the classical electrodynamics. I. e. the magnetic energy of the electrons in the atom during emission of photons, as a result of their centripetal acceleration when moving from a higher to a lower orbital, is transformed into an momentum of electromagnetic waves, called photon. And the absorption of a photon by the electron of an atom (molecule) increases its kinetic energy or, in essence, increases its velocity v, and along with it increases the centrifugal acceleration of the electron $\left(a_e = \frac{v^2}{r}\right)$, because of which the electron is moved to a higher orbital of distance $\Delta r = a_c \Delta t_c^2$ $\left(t_c \approx 10^{-8} s\right)$ by the centrifugal force $\vec{F}_c = m_{e0}.\vec{a}_c$. This is the mechanism of emission and absorption of photons (momentums of electromagnetic waves), which last tome $\sim t_c$ and move in vacuum at velocity c, i. e. the length of the photon is $l_f = c.t_c$, therefore, the photons are not points but have a length and a cross section $0 < S_f << 1\, mm^2$.

7. Niels Bohr and model of the atom

1. In his article* "On the building of atoms and molecules" of 1913, Bohr finishes with the paragraph „Conclusive notes", where the „Main suppositions" are as follows:

1.1. The emission (or absorption) of energies does not take place all the time, as it is understood by the standard electrodynamics, but only when the systems undergo transition from one into another „stationary" state.

1.2. "The dynamic balance of the systems in stationary states is determined by the standard laws of mechanics, whereas during the transition of the systems between the different stationary states these laws are not valid."

1.3. "The energy of the monochromatic emission, during the transition of the systems from one into another stationary state with frequency ν is $W = h.\nu$, where h is Planck's constant.

2. In the article** „On the application of the quantum theory to the atom structure", in section „Fundamental postulates of the quantum theory, in Chapter I, „§-1, First fundamental postulate" he writes „The first postulate of the quantum theory about closed atomic systems states that between the possible relative motions of the particles of the atom, there must exist so-called stationary states, which are distinguished by a peculiar stability".

Chapter II. §1. Second fundamental postulate reads: "The second postulate states that the release of emission, which is associated with such a transition, is a consecutive emission of purely harmonic waves, the frequency ν of which is determined by the so called condition of the frequency:

$$h.\nu = W_1 - W_2 ; \qquad \text{(B)}$$

where: W_1 *and* W_2 are the energies of the atom in the two stationary states"… "This postulate widens the gap between the new ideas and the classical electrodynamics, which is outlined in the first postulate, too."

3. In his article "The quantum theory of the emission"*** in §1. Principles of the quantum theory" N. Bohr shows a tendency toward accession between the classical (Maxwell's) electrodynamics and his ideas about quantum mechanics, before the appearance of Schrödinger's equation and de Broglie's waves, by writing:

– "The general description of the phenomena of emission, absorption, diffraction and dispersion of the light can be obtained on the basis of the supposition that the atoms contain electrically charged particles, which can

---

* "On the Constitution of Atoms and Molecules. Phil. Mag. 1913, 26, P. 1-25 (Part II), P. 857-875 (Part III).

** Über die Anwendung der Quantheorie auf den Atombau. Grundpostilate der Quartertheorie. Zs. f. Phys. 1923, 13, 117-165.

*** The quantum Theory of Radiation (With H. Kramers and J. Slater) Phil. Mag. 1924, 47, 785-800.

perform harmonic oscillations around the position of stable balance and which can exchange energies and momentums with the emitting field, according to the laws of the classical electrodynamics."

- "Proceeding from the classical concept of the emission and absorption of particles, which perform harmonic oscillations, Planck ascertained that, in order to achieve accord with experiments on thermal radiation, it is necessary an additional prerequisite to be introduced that in the statistical distribution only certain oscillations of particles should be taken into account."
- "Regardless of the fundamental difference of the quantum theory of the atomic processes from the theory, which is based on the standard electrodynamics, it in a certain sense should be a natural generalization of the latter."

Emphasis. The three citations express the tendency in the quantum theory to unite with the classical electrodynamics.

We I. Newton's view*, given in 1704, should also be added, which reduces to the statements (presented here in a synthesized form).

- The light consists of tiny bodies - particles.
- All bodies emit and absorb light, the light converts into bodies, and bodies convert into light. These are normal natural processes.

In this sense is also

4. *The principle of congruence in Bohr's model*

This principle states: The application of Bohr's model (which explains the phenomena in the microworld) to problems form the macroworld gives (leads to) results, which are obtainable by classical methods.

In this respect, Bohr's postulates result from the classical electrodynamics, as follows.

- *The first postulate.* From §-1. "On the angular momentum … proves that when the kinetic energy of the electron in the atom does not change, its angular momentum is constant and it moves along a stationary orbital. This circumstance reveals that N. Bohr intuitively reflected the above classical law.
- *The second postulate.* From §-1. "On the angular momentum …" cases A and B make it evident that the orbitals of the electron change when its kinetic energy changes in absorption and emission of kinetic energy in the form of a photon. And this is a result of classical physics (mechanics and electrodynamics).

Another result, directly from the classical electrodynamics, as a proof that the second postulate is an expression of the classical laws is the presented in §-3. "Model of the classical…" in receiving the energy emitted by the electron, i. e. that the electron must move from one to another orbital. In result of which its kinetic energy changes, respectively the radiuses of the orbitals and the velocities of the electron change.

In the literature about Bohr's model of atom, there are sometimes 4 postulates cited, but in Bohr's articles there are only two postulates, as given above.

8. Conclusion to part I

The processes of emission and absorption of photons (kinetic energies) by the electrons in the atoms can be described only by the laws of classical physics and they should be interpreted only as classical processes, when further developing the classical electrodynamics.

Part II
Unreality of de Broglie's waves

1. Basic formulations and analysis of the laws of de Broglie's waves

On the essence of de Broglie's waves, set fourth in the book "Quantum Physics, Berkeley Physics course. Vol. IV by E. H. Wichmann, McGraw-Hill book company, 1967.

1. In §-1. he writes: "The material particles have wave properties. This simple experimental fact is widely known."

2. In §-35. he writes: "*De Broglie's waves are not waves, which move along with the classical particle and lead it. De Broglie's waves and the particle - this is the same object. And there is nothing else. The reality is that the particles are a natural fact and have the properties of waves."*

3. In §-29. he writes: "The electrons have wave properties, but they are not waves in the classical sense, because the electronic wave packet cannot be split, in contrast to the classical wave packet."

4. In §-4. he writes: *"It is sensible the velocity of the particle with mass m to be identified with the group velocity."*

5. In §-5. he writes: "We assume that the dependence $W_0 = \hbar.\omega$, which holds true for the photon, holds true for the material particles as well. Then

$$\hbar.\omega = W_0 = \frac{m.c^2}{\left[1-\left(v^2/c^2\right)\right]^{1/2}}; \qquad (1\text{-}1)$$

whence at (5a)

$$\text{a)}\ \frac{1}{v} = \frac{dk}{dw};\ \text{or b)}\ v = \frac{dw}{dv}.\frac{dv}{dk}; \qquad (1\text{-}2)$$

from (1-1) the result is

$$\text{a)}\ \hbar.k = \frac{m.v}{\left[1-\left(v/c\right)^2\right]^{1/2}} = p; \qquad (1\text{-}3)\text{a}$$

or in vector form

$$\hbar.\vec{k} = \vec{p}; \qquad (1\text{-}3)\text{b}$$

This is exactly the expression proposed by de Broglie."

where: $\hbar = h/2\pi$ - is Planck's constant: $\omega = 2.\pi.\nu$ - the angular frequency; ν - the

frequency; κ – the wave vector; p - the momentum; c - the velocity of light in vacuum.

6. In §-7. he proves that it follows from the wave equation and Lorentz transformations that

$$\text{a) } \omega_B = \frac{\left(mc^2/\hbar\right)}{\left[1-\left(v/c\right)^2\right]^{1/2}}\text{; b) } k_B = \frac{\left(mv/\hbar\right)}{\left[1-\left(v/c\right)^2\right]^{1/2}}; \tag{1.4}$$

and from (1-4) it follows

$$\text{a) } W_0 = \hbar.\omega_B = \frac{m.c^2}{\left[1-\left(v/c\right)^2\right]^{1/2}}\text{; b) } p = h.k_B = \frac{m.v}{\left[1-\left(v/c\right)^2\right]^{1/2}}; \tag{1-5}$$

where: W_0 is the full energy of the particle with value

$$W_0 = m.c^2 + \frac{m.v^2}{2}; \tag{1-6}$$

7. In §-9. he proves that

$$\text{At a) } \frac{mv^2}{2} << m.c^2\text{; b) } \lambda_B = \frac{h}{m.v} = \frac{h}{p}; \tag{1-7}$$

8. From the presented above, it follows that the frequency of de Broglie's waves in a nonrelativist form is

$$\nu_B = \frac{v}{\lambda_B} = \frac{m.v^2}{h} = \frac{v.p}{h}; \tag{1-8}$$

9. In a systematized form the quantities of de Broglie's waves according to E. H. Wichmann are:

$$\text{a) } \lambda_B = \frac{h}{m.v}\text{; b) } \nu_B = \frac{m.v^2}{h}\text{; c) } k_B = \frac{\omega_B}{v} = \frac{2\pi.m.v}{h}\text{; d) } W_0 = h.\nu_B = m.v^2\text{;} \tag{1-9}$$

10. The following values in Table 1 below, computed by the author of this book according to the presented above by Wichmann about the electron, are given for orientation about what the parameters are of electromagnetic waves associated with the electron and the analogous parameters of de Broglie's waves also associated with the electron.

Table I

A. Electromagnetic waves	B. De Broglie's waves	
1. Length of the waves		
a) $\lambda = \frac{h.c}{m_{e0}.c^2} = \frac{h}{m_{e0}.c} = const.$;	b) $\lambda_B = \frac{h}{m_{e0}.v} \neq const.$;	(2-1)
2. Frequency of the waves		
a) $\nu = \frac{c}{\lambda} = \frac{m_{e0}.c^2}{h} = const.$;	b) $\nu_B = \frac{v}{\nu_B} = \frac{m_{e0}.v^2}{h} \neq const.$;	(2-2)

3. Wave energies		
a) $W_e = h.\nu = m_{e0}.c^2 = const.$;	b) $W_{eB} = h.\nu_B = m_{e0}.v^2 = 2W_k = 2\left(\frac{m_{e0}.v^2}{2}\right) \neq const.$;	(2-3)
Here the relation in non-relativist conditions is		
a) $k_w = \frac{W_{eB}}{W_e} = \frac{v^2}{c^2} << 1$;	b) $v << c$;	(2-4)
i. e. only a small part of the full energy of the electron, which is		

$$W_0 = m_{e0}.c^2 + \frac{m_{e0}.v^2}{2} = m_{eo}c^2(1-\frac{v^2}{c^2})^{-\frac{1}{2}} \qquad (2\text{-}5)$$

is transformed into the presumed de Broglie's waves. Since in de Broglie's waves the internal energy of the bodies does not take part as an energy parameter according to citation 2. in §-35., the emphasis is on the text: "De Broglie's waves and the particle - this is the same object" moreover, regardless of (2-4) the fact that, according to de Broglie's formulae, the wave energy of these waves $W_{eB} << W_e$ (2-3) and (2-4), **which unfortunately nobody has computed, in the literature on quantum mechanics (without exception) all scientists claim and use the flawed formulation that the energy of de Broglie's waves W_0 (1-5)a and their momentum P (1-5)b are according to these formulae, while in reality for the full wave energy of de Broglie's waves the equation (2-3)b and the relation (2-4) from the table hold true. This fact shows that the law of energy conservation denies de Broglie's waves**. And thus citation 5. in §-5, is also denied, where he writes: "We assume that the dependence $W_0 = \hbar.\omega$, which holds true for the photon (he meant the photon into which the electron converts and which has energy $W_0 = \hbar.\omega = m_{e0}.c^2$ (P. P.'s note), holds true for the material particles as well. Then

$$\hbar.\omega = W_0 = \frac{m_0.c^2}{\left[1+\left(\frac{v}{c}\right)^2\right]^{1/2}}; \qquad (1\text{-}1)$$

In reality (2-3)b and (2-4) hold true, and thus the real existence of de Broglie's waves is disproved.

Another example – with the electron in the atom at velocity $v = 10^6$ *m/s* ($v << c$)

There are full energies by Maxwell W_0 and by de Broglie W_{0B}

$$W_0 = m_{e0}.c^2 + \frac{m_{e0}.v^2}{2} = 9{,}1.10^{-31}.9.10^{18} + \frac{9{,}1.10^{-31}.10^{12}}{2} =$$

$$= 8{,}19.10^{-14} + 4{,}5.10^{-20} \approx 8{,}19.10^{-14}\,J$$

$$W_{0B} = W_B = m_{e0}.v^2 = 9{,}1.10^{-31}.10^{12} = 9{,}1.10^{-19};$$

The relation is

$$k_{\mathrm{W}} = \frac{W_{\mathrm{B}}}{\mathrm{W}_0} = \frac{9{,}1.10^{-19}}{8{,}19.10^{-14}} = 1{,}1.10^{-5}$$

or according to (2-4)

$$k_{\mathrm{W}} = \frac{m_{\mathrm{e}0}.v^2}{m_{\mathrm{e}0}.c^2} = \frac{\mathrm{v}^2}{\mathrm{c}^2} = \frac{10^{12}}{9.10^{16}} = 1{,}1.10^{-5}$$

For de Broglie's waves, valid are the dependences

$$\text{a) } \lambda_{\mathrm{B}} = \frac{h}{m.v}\text{; b) } \nu_{\mathrm{B}} = \frac{m.v^2}{h}\text{; c) } W_{\mathrm{B}} = m.v^2 = 2W_{\mathrm{k}} = 2.\frac{mv^2}{2}; \qquad (1\text{-}10)$$

Wichmann gives evidence in Ch. 5. §-13 that de Broglie's waves exist by writing: "We adduce typical experimental data: $W_0 = 54\,eV$, the maximum of the intensity is observed at $\theta = 50°$. For *n = 1* the observable meaning of θ corresponds to the length of the wave $\lambda = 1{,}65\ \ddot{A}$, and the length of the wave (of de Broglie – P. P.'s note) computed by the formula (11a) is equal to $\lambda = 1{,}67\ \ddot{A}$; this is a good compliance, if we allow for the mistakes during the measurement. Devison observed the maximum of a higher order, which corresponds to *n > 1* and their results proved to be in congruence with the results predicted by the theory."

It is necessary to emphasize that the above evidence for the existence of de Broglie's waves is based only on identical lengths of waves, and one wave (of the roentgen rays - this was said above in §-13) is measured, and the other of de Broglie's waves, is only computed. But ***this is not sufficient, since the full characterization of identity requires that the waves should have identical velocities, frequencies and energies.***

Here is how things really are.

A. For $\lambda = 1{,}65\ \grave{A}$, according to the text in §-13. from Ch. 5, the length of the wave of roentgen rays is measured, i. e. rays, which have velocity *c*.

The frequency of the waves is

$$\nu = \frac{c}{\lambda} = \frac{3.10^8}{1{,}65.10^{-10}} = 1{,}8.10^{18}\ Hz$$

The energy of the photon of roentgen rays is

$$W_{\mathrm{f}} = h.\nu = 6{,}62.10^{-34}.1{,}8.10^{18} = 1{,}2.10^{-15}\,J$$

B. For $\lambda = 1{,}67\ \grave{A}$.

The velocity of the electron is

$$v_{\mathrm{e}} = \frac{h}{m_0.\lambda_{\mathrm{B}}} = \frac{6{,}62.10^{-34}}{9{,}1.10^{-31}.1{,}67.10^{-10}} = 4{,}3.10^6\ m/s$$

the frequency of de Broglie's waves is

$$\nu_{\mathrm{B}} = \frac{v_{\mathrm{B}}}{\lambda_{\mathrm{B}}} = \frac{4{,}3.10^6}{1{,}67.10^{-10}} = 2{,}57.10^6\ Hz$$

the energy of de Broglie's waves is

$$W_{\mathrm{B}} = h.\nu_{\mathrm{B}} = 6{,}62.10^{-34}.2{,}57.10^{16} = 1{,}7.10^{-17}\,J$$

It follows from the above data that the energy of de Broglie's waves in percentage related to the roentgen waves is

$$W_{\mathrm{B}}(\%) = \frac{W_{\mathrm{B}}.100}{W_{\mathrm{f}}} = \frac{1{,}7.10^{-17}}{120.10^{-17}}.100 = 1{,}4\%$$

i. e. only 1,4%

This fact reveals that the conclusion thus made about the identity of the two types of waves based only on the length of the waves, is entirely ungrounded and inconsiderate.

Furthermore, the electrons in the atom at velocity $v = 5.10^6$ *m/s*, have length of the wave λ, frequency ν_{e} and energy W_e respectively equal to

a) $\lambda_{\mathrm{e}} = \frac{h}{m_0.v} = \frac{6{,}62.10^{-34}}{9{,}1.10^{-31}.5.10^6} = 4{,}27.10^{-8} m$;

b) $\nu_{\mathrm{e}} = \frac{v}{\lambda_{\mathrm{B}}} = \frac{5.10^6}{4{,}27.10^{-8}} = 1{,}17.10^{14}\ Hz$;

c) $W_{\mathrm{e}} = h.\nu_{\mathrm{e}} = 6{,}62.10^{-34}.1{,}17.10^{14} = 7{,}75.10^{-20} J$;

How could it be possible for an electron, at this energy $W_{\mathrm{e}} = 7{,}25.10^{-20} J$ *of de Broglie's waves, to emit a photon with energy* $W_{\mathrm{f}} = 1{,}2.10^{-15} J >> W_e$*? That is impossible, of course*. This is the proof that the electrons in the atom cannot be considered as de Broglie's waves, and it follows from this fact that Schrödinger's equation does not reflect a physical reality.

The use of Schrödinger's equation to obtain some reliable truths is a result of ascribing unreal properties to de Broglie's waves. For example, W. Pauli in his article "Die allgemeinen Prinzipen - der Wellenmechanik"-In& Handbuch der Physik. Bd.24. Teil 1.1933 , in §-1. writes:

"The final crucial turn in quantum theory occurred thanks to the discovery of the waves of de Broglie's matter, advancement of matrix mechanics of Heisenberg and the appearance of the general wave-mechanic differential equation of Schrödinger, which made it possible to connect these two circles of ideas."

"The notion of light quanta was introduced to enable the computation of the exchange of the energy of momentum between light and substance." … "The laws for conservation of energy and momentum are strictly observed." … "If momentum $p = \frac{\hbar.\omega}{c}$ is assigned to the light quantum, and the energy is $\hbar\omega\left(\hbar = \frac{h}{2\pi}\right)$. Proceeding from the vector $\left|\vec{k}\right| = \frac{\omega}{c}$, we can write:

$\vec{p} = \hbar\vec{K}$; $W = \hbar.\omega$ (I)

... "that normal matter has wave properties, too, moreover, here the wave vector and the frequency of the waves are determined by the relations (I) as well, which are now considered to be universal (P. P.'s cursive). Existence of the waves-particles dualism and the reliable veracity of the correlation (*I*) for matter as well - this is the

actual content of de Broglie' s hypothesis about the waves of matter."

However, there is a discrepancy between science and reality, since with electromagnetic waves the energy is

$$W = h.\nu = m.c^2 ; \qquad (A)$$

whereas with de Broglie's waves the energy is

$$W_B = h.\nu_B = m.v^2 = 2W_k = 2\left(\frac{mv^2}{2}\right) << W ; \qquad (B)$$

i. e. the correlations (I) do not hold true for de Broglie's waves. They would be valid, if the velocity $v = c$. *And when only the length of the wave is used for comparison, the inreality is conspicuous.*

Moreover, it has not been proved that de Broglie's waves can be attracted by the atomic nucleus so as to move around it and within the atom.

Furthermore, it has not been proved that de Broglie's waves can be attracted by the nucleus of the atom so as to move around it and inside the atom.

Schrödinger in his first publication in Amn. Physic. 1926. 79.361. as well as later in the article "The wave theory of the mechanics of the atoms and the molecules" in Phys. Rev.1926.28.1049. l §-1, wrote: "The theory, which is set fourth on the following pages is based on the very interesting and profound research of L. de Broglie on the so called „phase waves" and is applicable to the motion of the material particles, in particular to the electron and the proton."

E. H. Wichmann* in Ch. 7 "The wave mechanics of Schrödinger", §-7., wrote: "The theory of Schrödinger is based on the wave equation, which is known under the name of Schrödinger's equation. His solution is de Broglie's wave „bound" with the particle".

Wichmann in Ch. 9. „Elementary particles and their interactions" under the title „Basic ideas of the quantum theory of field", in §-32, wrote: "The classical idea of two particles interacting with forces corresponds to the quantum mechanical idea of interaction between de Broglie's waves. This means that de Broglie's waves of one particle exert influence on the propagation of de Broglie's waves of the other particle." In §-40, he wrote: "If the interaction between the particles is implemented through a field, this field must be in the form of freely propagating and energy-carrying waves". And in §-41, he wrote: "**In quantum physics, we formulate a theory of the field which in essence is de Broglie's waves of the particles.**"

2. Conclusion

Since the essence of the theory of the wave, quantum mechanics, depends on de Broglie's waves, and their existence is questionable, this theory should be given a second thought in the spirit of actual facts, the most fundamental of which are the theories of Max Planck and Niels Bohr.

---

* E. H. Wichmannл Quantum Physics. Berkeley Physics course. Vol. IV. McGraw-Hill Book company.

P.S. *The theory of de Broglie's waves is another fragment on the road of history of physics.*

Part III
On Heisenberg's inequation

This inequation states: The impreciseness in the definition of the coordinate in Δx microphysics is connected with the impreciseness in the definition of the momentum Δp of the particle, or the impreciseness in the definition of its energies ΔW is function of the impreciseness of the time Δt, and two variants are given a) and b) of Heisenberg's inequation.

a) $\Delta p.\Delta x \geq h$; b) $\Delta W.\Delta t \geq h$; (1)

But when we take into the account the fact that in the wave processes, the frequency $\Delta \nu$ is equal to $1/\Delta t$, i. e. $\Delta \nu.\Delta t = 1$ then, applying it in (1)a, it follows

a) $\Delta p.\Delta x = \Delta p.\Delta v.\Delta t \geq h$; b) $\Delta p.\Delta v = \Delta W = \dfrac{h}{\Delta t} = h.\Delta \nu \rightarrow \Delta W \Delta t > h$; (2)

but the expression (2)b when using only of the equation (=) is equal to

a) $\Delta W = h.\Delta \nu$; $\rightarrow$ b) $W_f = h.\nu$; (3)

i. e. *this is a notation of the law of the energy of the photon - W_f and at the same time is a notation of the conservation of the energy of the photon.*

In this sense, so that W_f can increase, according to (2)b, additional energy $W_f = \Delta W - W_f$ is needed, a fact which is denied by the law of energy conservation. That is why if such data are obtained in measurement, they are considered invalid, as it is in macrophysics, too.

It is well known that N. Bohr's model gives sufficient results with the analysis of the hydrogen atom, where there is interaction between two bodies.

With more than two bodies, say 3, 4, …, n this model still holds true, but there is no solution for atoms with 2, 3, …, n electrons. The reason is that the problem of interaction between 3 or more bodies in physics has not been solved so far.

It is essential to emphasize that so far there has not been a single experimental validation of Heisenberg's inequation. Without such a validation, however, there is no reason to claim that it is a physical law.

Part IV
Emphasis. On Schrödinger's equation

A. The use of Schrödinger's equation to obtain real, specific numerical values of probabilities for the state of the electrons in the atom, with features of real physical quantities is impossible. This statement is grounded on the following facts:

1. In principle, it is impossible to give real boundary conditions for the quantities associated with the states of the electrons, such as: a) the radius; b) the potential and c) the kinetic energy. And they are components of Schrödinger's equation without which no specific, real solution can be obtained.

2. In principle, there is no real method for measuring the specific real numerical values of the probabilities.

3. There are no known experimental data, validating that this equation describes real phenomena, referring to the electrons in the atom or a specific comparison of obtained specific experimental numerical values for specific boundary conditions with experimental data on the same conditions, as it is done for all real physical laws and theories.

4. There is no experimental validation of the formulations, which are used in this equation, such as:

4.1. that the electrons in the atom are in the form of de Broglie's waves and that they, being waves, move in the closed space of the atom around its nucleus and that the electrons do not have a trajectory because they are waves.

4.2. How could it be explained why, in Schrödinger's equation, there is a radius with the nucleus as its center since the claim is that the electrons do not have trajectories; the availability of this radius speaks exactly of the opposite.

4.3. That, for a short time, the energy of the electrons as waves can have values greater than those determined by the law of energy conservation. And there are no experimental data that for the electrons, as de Broglie's waves, the law of energy conservation does not hold true.

B. **Inferences**

1. Schrödinger's equation does not describe real physical phenomena (facts); that is why there are not any specific experimental data validating it.

2. It is a serious physical error to claim that the law of energy conservation is not obligatory for a short time for Schrödinger's equation, which can be motivated through Heisenberg's inequation, because there are no experimental data validating this equation.

C. **Conclusion**

With the present situation of interpretation of Schrödinger's equation, there is no reason to assume that this equation reflects real physical facts (phenomena). That is why it should not be used as a physical law, but should be dropped off from quantum mechanics, because this is a logically unsustainable and experimentally invalidated theory.

Part V
General inferences

First

The reliable part of the present-day quantum mechanics should be without de Broglie's waves, without Schrödinger's equation and without Heisenberg's inequation.

***Id est, by assuming that M. Planck's theory is a continuation (further development) of the theory of Maxwell and Faraday and that the quantizing of the energy in the form of photons is a result of the classical electrodynamics, it follows that* the real theory of quantum processes, which has been experimentally validated, has its grounds only in classical physics.**

Second

There is no reason to claim that quantum mechanics is a general science (theory) about the natural phenomena, because:

a) it interprets only microphenomena of individual objects out of a whole ensemble of objects and most often describes their one-moment manifestations by means of probabilistic laws, but it does not give their laws for a prolonged interval of time, when the laws, according to experiment are deterministic, not probabilistic, such as is Stefan-Boltzmann law.

b) It does not interpret the integral laws of the ensembles of phenomena of microobjects, either, where the microobjects are structural elements of the structure of the ensembles, whose laws are deterministic and are a result (function) of the probabilistic manifestations of the microobjects.

c) Moreover, the laws of the ensembles, as a unitary structure are deterministic by ignorable (inconsiderable) fluctuations.

In this sense, quantum mechanics is only part of the science of nature – of the science physics.

Third

In essence, quantum mechanics interprets only microelectromagnetic manifestations of the electromagnetic matter; therefore, **it is more appropriate to use only the term quantum electrodynamics**.

4. Supplement IV
Flaws in thermodynamics

1. Introduction: notes and inferences

The beginning of the studies of thermal manifestations of electromagnetic energy was in times, long before electromagnetic energy was discovered and used in practice.

This circumstance justifies the development of a science dedicated to thermal processes and named thermodynamics. More specifically, the term „thermodynamics" was introduced by W. Thomson in 1854, who changed the original name of this section of physics, which had been called „mechanical theory of the heat". In general, the development of modern equilibrium thermodynamics was started in 1824 with "Reflections on the moving force of fire" by S. Carnot, where he proposed Carnot's cycle.

On the development and the archaisms in thermodynamics, Prof. N. A. Kvasinkov* wrote in 2002: *"For historical reasons thermodynamics was created not by one generation of scientists, but by several generations, so there are a lot of viewpoints in it, various approaches, different formulations of the same qustions, variety of designations, etc. This accounts for certain heterogeny of material" and furher (on p. 35)* he writes: **"Thermodynamics is not a unitary and universal theory. Its sphere of application and its capacities are limited." On p. 192 he also writes: "The problems of thermodynamics can be solved without the notion of entropy… and so forth, by using only immediately measurable quantities."**

By the beginning of 20th c. it had become clear that the thermal energy is electromagnetic wave (ray) energy in the form of an ensemble of electromagnetic elementary particles, called photons, and their ensemble is called photon gas. This fact is evident in the publications of G. Kirchhoff in 1860, L. Boltzmann in 1884, Max Planck in 1900, J. C. Maxwell in 1873 and in the experimental results of P. Lebedev in 1900, who proved Maxwell's* thesis that the photons** generate momentum $\vec{p}_f$, respectively pressure $p = w$ (where w is the density of electromagnetic energy) and that is why photons can do work, i. e. for the electromagnetic energy, Maxwell's pressures hold true, which lead to the inferences that:

- *The electromagnetic (thermal) energy ΔW moves from places of higher pressure p_1 (higher density of the energy w_1) to places of lower pressure $p_2 < p_1$ (lower density of the energy $w_2 < w_1$) at distance Δr_{12}:*
- I. e. the quantity ΔQ of electromagnetic (thermal) energy, in the form of an

---

* N. A. Kvasnikov. Thermodynamics and Statistical Physics. v. 1.Theory of equilibrium systems. Thermodynamics. (in Russian) Editornal URSS. Moscow. 2002 (p. 13).

* Maxwell. "Treatise on Electricity and Magnetism", 792, 1873

** The notion of photon was introduced in 1926

ensemble of photons (photon gas), which moves from point 1 with pressure p_1 (w_1) at distance Δr_{12} to point 2 with pressure p_2 (w_2) through cross section Δs for time Δt, which is proportional to the difference $\Delta w_{12} = w_1 - w_2$, and where applicable is the law

$$\Delta Q = -\frac{k.\Delta w_{12}}{\Delta r_{12}}.\Delta s.\Delta t \; ; \qquad (1\text{-}1)$$

This law in differential form is

$$dQ = -k\frac{dw}{dr}.dS.dt \; ; \qquad (1\text{-}2)$$

where: the sign is minus because the thermal energy moves from higher densities of the energy to lower ones; k - physical coefficient of proportionality.

This is Fourier's law and it is a consequence of the theory of Maxwell's pressures of 1873 which was validated by P. Lebedev in 1900.

In параграф 792, Maxwell writes: *"In a medium where electromagnetic waves propagate, pressure is generated in direction of the waves, which is numerically equal to the quantity of energy in a unit of volume."*

And the energy in a unit of volume has energy density w. The mathematical notation of Maxwell's pressure is

$$\text{a) } p = (\rho.c).c = \rho.c^2 = w \; ; \text{ b) } \rho = \frac{w}{c^2} \; ; \text{ c) } c^2 = \frac{w}{\rho} \; ; \qquad (1\text{-}3)$$

where: ρ is the density of the mass of the electromagnetic waves; c – their velocity; w – the density of their energy.

The pressure p on surface $S \neq 1$, to which corresponds volume $V = S.1$, is

$$\text{a) } \rho = p.S.1 = \rho.V.c = m.c = \frac{W}{c} \; ; \text{ b) } m = \frac{W}{c^2} \; ; \text{ c) } W = m.c^2 \; ; \qquad (1\text{-}4)$$

here

$$\text{a) } \rho = \frac{m}{V} \; ; \text{ b) } w = \frac{W}{V} \; ; \qquad (1\text{-}5)$$

Proceeding from the formulae for the coefficients of thermal content c_p and c_o at constant pressure or volume

$$\text{a) } c_p = \left(\frac{dQ}{dT}\right)_p \; ; \text{ b) } c_v = \left(\frac{dQ}{dT}\right)_v \; ; \qquad (1\text{-}6)$$

written for the density of the thermal energy

$$\text{a) } c_p = \left(\frac{dw}{dT}\right)_p \; ; \text{ b) } c_v = \left(\frac{dw}{dT}\right)_v \; ; \qquad (1\text{-}7)$$

for the differential of the density of the thermal energy is derived:

$$\text{a) } dw = c_p.dT \; ; \text{ b) } dw = c_v.dt \; ; \qquad (`1\text{-}8)$$

Replacing dw from (1-8) in the equation (1-2), we obtain

$$dQ = -\lambda.\frac{dT}{dr}.dS.dt\ ; \qquad (1\text{-}9)$$

This is the experimentally defined Fourier's law of 1822, which is a direct consequence of the law of Maxwell's pressures of 1873 and was experimentally validated by Lebedev in 1900. Here the coefficient of proportionality is λ and is called thermal conductivity with dimensionality [$J.S^{-1}.m.K$].

Fourier's law (1-9) is the embryo out of which developed the non-equilibrium (dynamic) thermodynamics, in which at *t = 1 = const.* can be described the equilibrium states of the thermal phenomena.

For example, when applying the correlation (1-4)c $W = m.c^2$ of Maxwell's law to Fourier's law (1-9), the result is Fick's law

$$dm = -\chi.\frac{dm}{dr}.dS.dt\ ; \qquad (1\text{-}10)$$

which was experimentally established by Fick in 1855.

The laws of electrodynamics, set forth above, which hold true for the thermal processes, too, result into some regularities, which are essential, even fundamental, initial formulations (laws) of equilibrium thermodynamics such as:

2. On Carnot's cycle (1824) and Clausius' entropy (1854)

Here, after Carnot's cycle is accepted ad hoc, which is in contradiction with the initial assumption of equilibrium state of the gas, it is assumed that there is motion (very weak, so that there are no losses and the processes can be called reversible), although equilibrium (immovable) state of the system is meant. However, even the slightest motion (at a slow velocity) always has velocity $v > 0$ and energy losses because they are $\Delta Q = k.v > 0$, i. e. the assumption of Carnot's cycle is flawed, but the inferences on

a) Carnot's law and b) The efficiency factor

$$\text{a)}\ \frac{Q_1}{T_1} - \frac{Q_2}{T_2} = 0\ ;\ \text{b)}\ \eta = \frac{T_1 - T_2}{T_1} = 1 - \frac{T_2}{T_1}\ ; \qquad (2\text{-}1)$$

are correct, because they are a consequence of more general laws, which are experimentally validated, such as: a) the coefficient of thermal content (heat capacity) c_p or c_v (1-6) and b) the universal definition of the efficiency factor η, which states: The efficiency factor is a relation of the difference between the incoming energy $W_1 = Q_1$ and the left energy (after work has been done ($A = F.r$) $W_1 = Q_1$, to the incoming $W_1 = Q_1$ energy, i. e.

$$\text{a)}\ \frac{Q_1}{T_1} = c_p = \frac{Q_2}{T_2}\ ;\ \rightarrow \frac{Q_1}{T_1} - \frac{Q_2}{T_2} = 0$$

$$\text{b)}\ \eta = \frac{Q_1 - Q_2}{Q_1} = \frac{c_p T_1 - c_p T_2}{c_p} = \frac{T_1 - T_2}{T_1} = 1 - \frac{T_2}{T_1}\ ; \qquad (2\text{-}2)$$

It is evident that we do not need the unreal Carnot's cycle to derive the laws (2-2), since in essence this cycle can really never be conducted. On the other

hand, according to the principle of simplicity (Occam's razor), the fewer and the simpler the initial principles of a theory are, the more reliable and perfect that theory is. Therefore, Carnot's cycle from the theory of the thermal processes should be dropped off and replaced, perhaps by that from the conclusion of (2-2).

The material set forth above (2-2) enforces a few evident theses (truths).

First. *The laws of thermal energy are not probabilistic, a deterministic.*

Second. *The thermal (electromagnetic) energy moves from places of higher energy density (of higher temperatures) to places of smaller energy densities (of lower temperatures), according to the dynamic Fourier's law.*

Third. *Carnot's cycle is not needed in thermodynamics.*

3. On the notion of entropy

So that a notion can be recognized as a physical quantity, according to the methodological principle of a physical reality (truth), it is required: **a) that the notion should have a unit of quantitative measurement for determining of its numerical value; b) that the notion should have a strictly defined, feasible method of measurement.**

The entropy does not meet these requirements because its flaws disprove it most categorically, i. e. **it is not a real physical quantity and it has no place in physics. but** there is another flaw, introduced by L. Boltzmann, who defines it without any grounds as probabilistic quantity, despite Fourier's law and the statistical physics, as follows:

First. Entropy was introduced in thermodynamics by R. Clausius* in 1854 when he wrote: **"For all reversible processes, as a mathematical description of the second principle of the mechanical theory of heat is the equation** a) and **later, the equation** b)

$$\text{a) } S = \int \frac{dQ}{T} \geq 0 \text{ ; b) } dS = \frac{dQ}{T} \geq 0 \text{ ";} \qquad (2\text{-}3)$$

This second principle of thermodynamics is for externally isolated thermodynamic systems, where (inside them) run processes „by themselves" without external interference. Gelfer** writes on p. 237: "**There is no use of these inequations (2-3) for the specific computations of thermal processes because**

First. They are inequations.

Second. There are no indications in them for the velocity of the process."

Moreover, we can add that there is no method as well of measuring the entropy therefore there is no reason to use it and least of all, to use it as a second principle (law) for a principle must have experimental validation.

---

* Clausius R. Abhandlccngen ???ber die mechanische W???ran. theorie. Abt. 1. Braunschweig. 1854.

** Gelfer, J. M. History and Methodology of Thermodynamics and Statistical Physics. Publ. V. III. Moscow, 1981.

4. On the statistical method in equilibrium and reversible thermodynamics

Equilibrium and reversible thermodynamics is modern thermodynamics, which we shall call here orthodox thermodynamics.

Two laws for studying the thermal processes as given here, as follows, according to F. Reif [***], paragraph 7.4. "Fundamental principles of statistical thermodynamics" where he writes:

„First law of thermodynamics,

The equilibrium macrostate of an isolated thermal system is characterized by constant internal energy.

a) $W_c = const.$; b) $T = const.$; c) $p = const.$; d) $V = const.$; (2-4)

Second law of thermodynamics.

When the thermal system absorbs thermal energy dQ its entropy changes by

$$dS = \frac{dQ}{T};$$

4.1. Statistical aspect

This aspect uses the assumption that in equilibrium state of the system, its thermal energy W_c is distributed uniformly among all N_0 particles (molecules, atoms). The mean thermal energy of one particle is equal to the ratio of the full thermal energy W_c to the number of the particles

$$\overline{W_{\mathrm{i}}} = \frac{W_c}{\mathrm{N}_0} = \frac{m_{\mathrm{i}}.\overline{v_{\mathrm{i}}^2}}{2} = \frac{1}{2}k_{\mathrm{Б}}.T; \qquad (2\text{-}5)$$

where: m_i *is* the mass of the particle; $\overline{v_{\mathrm{i}}^2}$ - the root mean square velocity of oscillation of the particle; $k_{\mathrm{Б}}$ - Boltzmann's coefficient.

Emphasis: F. Reif writes in paragraph "Problems" at the end of chapter I, in problem 1.9.: "**This result shows that the mean energy of the atoms (of the particles – P. P.'s note), in a system in equilibrium, is the same, even if the masses of the atoms are different.**"

From the law (2-5), which is experimentally validated for the energies of the particles of an equilibrium system the following detail laws also hold true:

a) $d\overline{W} = d\overline{Q} = c_{\mathrm{T}}.dT = 0^{'}; \rightarrow$ b) $dT = 0$; c) $w = n_0.\overline{W_{\mathrm{i}}} = \frac{W_{\mathrm{c}}}{V} = const.$; (2-6)

a) $T = \frac{W_{\mathrm{c}}}{\mathrm{N}_0.k_{\mathrm{Б}}} = T_{\min} = const.$; b) $\varepsilon_{\mathrm{i}} = \overline{W_{\mathrm{i}}} = \frac{1}{2}k_{\mathrm{Б}}.T = const.$; (2-7)

where: c_T – common symbol of the coefficient of thermal content; w - density of energy; n_0 - concentration of particles in a system of constant volume - V; ε_{i} - the

---

[***] F. Reif. Berkeley. Physics course. Statistical Physics. Vol. 5. McGraw-Hill. Book Company. (Translated into Russian and publ. by Nauka. Moscow, 1972)

energy of one particle.

4.2. Probabilistic aspect

According to Maxwell-Boltzmann law, the probability of the number N_i of particlesте N_0 of the system, which имат energy in intervala (ε_{i} до $\varepsilon_{\text{i}}+1$) is

$$\Delta N_{\text{i}} = N_0 \exp.\left(-\frac{\varepsilon_{\text{i}}}{\text{k}_{\text{Б}} T}\right); \qquad (2\text{-}8)$$

Here the ratio $\varepsilon_{\text{i}} \big/ \text{k}_{\text{Б}}.T$ is the interval of energy in units of $\text{k}_{\text{Б}}.T$. This eq. (2-8) is not about the mean value of the energy (2-3)a, which is in equilibrium state and so is not a probabilistic quantity, but is a strictly defined quantity of the full energy of the system W_c and the volume V

$$\varepsilon = \frac{W_{\text{c}}}{\text{V}} = const.; \qquad (2\text{-}9)$$

Strictly speaking, since in equilibrium state the energy ε is not a probabilistic quantity, the correlation (2-9) cannot be used for statistical regularities as (2-5), i. e. in equilibrium states.

In spite of this, however, it is used in modern orthodox thermodynamics, and this flaw is justified by the very slow motions (velocities). But *in physics, in such cases dynamics at low velocities is discussed,* **not statics at low velocities.** Moreover, such a flaw is to be found in Carnot's cycle as well, which is the core principle of the proof that heat can do work, and Fourier's law is never mentioned at all.

The development of the notion of entropy as a probabilistic quantity in equilibrium state is also flawed as an approach and as a real description because:

a) In equilibrium state - *dQ = 0 and dT = 0*, therefore:

$$\text{a)}\ dS = \frac{dQ}{T} = c_{\text{T}}.dT = 0\,;\ \text{b)}\ S = \int dS = 0\,; \qquad (2\text{-}10)$$

i. e. there is no entropy in equilibrium state

b) the definition of entropy involves the coefficients of thermal content c_T, respectively at constant pressure $c_{\text{T}} = c_p$ or at constant volume $c_{\text{T}} = c_v$, and the formula given by Boltzmann is the one for mols specified by M. Planck by k_B

$$\text{a)}\ S = \text{k}_{\text{Б}} ln\text{P}\,;\ \text{b)}\ P \geq 1\,;\ \text{c)}\ S > 0; \qquad (2\text{-}11)$$

where: k_B is Boltzmann's coefficient; P - the notion of thermodynamic probability, a new term, incompatible with the notion of probability, which is $P \leq 1$

5. Inferences

It is evident from the arguments on the notion of entropy set forth above that core methodological principles in science are not fulfilled, such as:

1. The principle of veracity – a criterion of truthfulness is the empirical validation of a scientific claim (quantity or theory). Or, as Aristotle put it, the claim (idea) must have its counterpart in nature.

There is no way to measure entropy, nor a unit of measurement to determine its

numerical value during a process. Moreover, there is no proof, either, of the equivalence of computation through deterministic computation according to formula (2-3) and formula (2-11). Last but not least, there is not any experimental validation.

Id est, according to this principle of veracity, it has not been proved that entropy is a reality, on the contrary, it is evidently a chimera.

2. The principle of simplicity (Occam's razor), which states that out of a few theories, which seemingly equally reliably explain the same phenomenon, the most perfect is that theory, which uses the least initial assumptions.

The question, is thermodynamics feasible without the notion of entropy, was answered by Prof. Kvasnikov in his book [*], paragraph 9 "Non-entropic methods in thermodynamics" where he writes on p. 192: *"We have shown that thermodynamic problems can be solved without using the notion of entropy, but operating only by immediately measurable macroscopic quantities.",* i.e**. the principle of simplicity denies entropy.**

3. The principle of recognition of the knowledge gained over centuries of scientific studies is not observed, because the laws of Fourier and Fick are disregarded. These laws clearly and unequivocally prove that: a) thermal energy moves from a place of higher temperature to a place of lower temperature; b) this process is strictly deterministic and unambiguous, not a probabilistic one; and c) thermal energy (heat) is something material, because gradient (dT/dr) is never used for something which is not real (material).

The notion of entropy is used as a second principle (law) of thermodynamics, **although thermodynamics can exist without it**. This is a real dead-end situation for thermodynamics, a huge and burdensome load of laws on entropy, without *which thermodynamics would be considerably more perfectly and unequivocally determined as well as shorter and universal for continuous (irreversible) and equilibrium processes.*

6. Conclusion

Thermodynamics must be liberated from the notion of entropy, which is nothing else but a chimera and should develop on the basis of experimental regularities, such as:

1. *Thermal energy is electromagnetic with a structure of a photon gas.*

2. *The laws of thermodynamics are specifically electromagnetic laws, which reflect photonic processes proceeding from Fourier's law, which is a consequence of Maxwell's law for Maxwell's pressures in electrodynamics*.

3**. By observing the above two regularities, which hold true for non-equilibrium and equilibrium (irreversible and reversible) processes, we can arrive at a unitary theory of thermal phenomena, which are electromagnetic phenomena**.

---

[*] I. A. Kvasnikov. Thermodynamics and Statistical Physics. V. 1. Theory of Equilibrium Systems. Thermodynamics. (in Russian) Editornal URRS. Moscow, 2002.

Afterword

1. The road of pioneers in science

In [1] (on p. 7) we can read: "In the history of science, it has been not a rare occasion **for scientists to fail to recognize a new breakthrough,** (*as is the case, for instance, with Newton's Optics in 1704 – P. P.'s note*) **even when it emerges before their eyes.** This may happen because of the observers' theoretical unpreparedness or for lack of a sufficiently developed theory in the store of collective knowledge, which will be able to assimilate the new observations". (*All cursives in this afterword as P.P.'s*).

Further, in [2] (p. 129) we read: "The carriers of old ideas and theoretical assuptions will not surrender without fight. That is why new idea only succeed in establishing themselves in decates or even centuries." The famous physicist Max Planck wrote: "In the 80s and 90s of last century (referring to 19th century – *P. P.'s note*), I realized how frustrating it feels when a researcher arrives at ideas superior to the dominant ones, for his voice is too weak to make the scientific society listen to him... **The old routines, ideas and assumptions in science, running counter to the new scientific data, are very viable.** They will hardly succumb to re-consideration; this is so because, more often than not, they are bound to a chain of other scientific assumptions. *The process of demolition of outdated scientific views affects the interests and prestige of a wide circle of scientists,* WHO WILL RESIST IN ANY WAY AGAINST THE INTRODUCTION OF THE NEW. Even inadmissible contrivances, very remote from scientific style, may be used sometimes, such as humiliation or public exposure of the carriers of new ideas. It is well known that *Newton's theory faced the opposition of so authoritative scholars in their times as* **Huygens, Leibnitz, Bernoulli, Euler, and others."**

According to Immanuel Kant, ONE OF THE HARDEST REFORMS IS THE ONE IN HUMAN THOUGHT.

2. Epilogue

The author of this book **does not believe** that the ideas and solutions proposed by him in **the first part of** the book will be readily accepted by the society of physicists, irrespective of the fact that *sufficient number of validating experimental (scientific experiments) are presented in support.* The author, however, hopes that sooner or later, in one or another form, **these ideas will cut a road through the official physical science. This hope is based on the circumstance that science is a self-adjusting system, which pursues the truth.**

As regards the **second part** of the book, probably most experts in TR *would look down upon the author from the tower of the artificially exalted image of Einstein as an infallible creator of a theory of genius. Or, they might feel sympathy to the author, as to a man* **in a pitiful plight** *with respect to something in his head.* What could be done with this author **in a pitiful plight**? *But even the most authoritative ideas will*

eventually be swept by the irresistible force of experimentally validated facts,

BEFORE WHICH EVEN SCIENTIFIC GENII, AS WELL AS GODS, WILL YIELD!!

In [3] (p. 228) M. Klein writes: "If history of science can teach us something, it is that **sooner or later the general theory of relativity will also be replaced by a more perfect theory."**

Therefore, even if that happens later rather than sooner, TR will only leave a trace in the history of physics, since science is an invincible fighter for truth, and such a fundamental truth, which is experimentally validated, cannot be found in TR!

Literature

1. Methodological Principles of Physics. Academy of USSR, Science, Moscow, 1975 (in Russian)

2. I. D. Andreev. The theory as a Form of Scientific Knowledge Organization, Science, Moscow, 1979 (in Russian)

3. M. Klein. Mathematics and the Search for Knowledge, Oxford University Press, 1975, Mir, Moscow, 1988 (in Russian)