Physical sciences

ON THE NON-EQUIVALENCE OF MASS AND ENERGY

Etkin V.A.
D-r Techn. Sc., prof.
(Integrative Research Institute)
ORSD ID 0000-0003-2815-1284

Abstract

It is shown that the existence of aether-like media as the primary source of all forms of matter in the Universe and considering the irreversibility of the process of their "reification" excludes the equivalence of energy and mass, postulated by A. Einstein in his special theory of relativity. A flagrant contradiction of this principle with the "mass defect" in the calculation of the energy balance of nuclear reactions has been revealed. A new interpretation of the processes of nuclear fusion is given as an analogue of the reactions of "combustion" of nucleon fuel. The extremely low efficiency of hot fusion power plants in comparison with other methods of using the energy of aether-like media is substantiated.

Keywords: mass-energy ratio, mass defect, coupling energy, reactions, and hot fusion units.

1. Introduction.

Currently, the processes of hot or cold nuclear fusion are interpreted as spontaneous processes accompanied by a "mass defect" - the difference in the masses of particles in a free and bound state due to the conversion of mass into energy. The very concept of "transformation" means the decrease of one thing and the increase of something else. However, this comes into blatant contradiction with A. Einstein's principle of equivalence of mass and energy, in which a decrease in mass is inevitably accompanied by a decrease in energy [1]. In addition, when interpreting the mass defect as a consequence of the “release” of the binding energy of nucleons, the circumstance is ignored that the energy and substance for the formation of these initial particles themselves were borrowed from the material environment, the existence of which was recognized by natural philosophy two millennia before the ether by R. Descartes. Meanwhile, the ether was expelled from the physics of the 20th century due to its “uselessness” for quantum mechanics (QM) and the special theory of relativity (SRT), which was due not only to the inconsistency of its models, but also to the concept of “exchange interaction”, which does not require the mediation of any or environment.

Therefore, the scientific community refused to return the ether to physics even after A. Einstein recognized its necessity for constructing the general theory of relativity (GR) [2], which was expressed in attempts to replace it with “physical vacuum”, “hidden mass”, “dark matter”, "dark energy", "quintessence", etc. Meanwhile, none of the models of these substances, be it a broth of virtual (non-material) particles in a void, a unipolar or electrically neutral plasma, a gas under high pressure, a superfluid liquid, a crystalline body, and etc. cannot claim the role of the primary form of matter (prematter), from which all types of matter in the Universe were formed. This is since such matter, unlike them, must have a minimum number of degrees of freedom. This circumstance forces us to abandon the ether model proposed by V.A. Atsyukovsky [3].

Since, according to the generally accepted modern model of lambda-CDM, the Universe consists of more than 95 percent of dark matter and dark energy and only 4.6% of baryonic matter (including protons, neutrons and electrons), it became impossible to ignore the existence of such a primary medium. , there is a need to revise the principle of equivalence and the concept of "mass defect". In this article, this is conducted from the standpoint of energy dynamics - the theory of the power of real processes of transfer and transformation of any form of energy [4].

2. General properties of aether-like media as the primary form of matter

The modern paradigm of natural science divides matters into substance and field [1]. Such a division is unacceptable, if only because the fields (scalar, vector, and tensor) are also present in matter. Much closer to the essence of the matter would be the division of matter into structured (baryonic) and unstructured (non-baryonic), which is its primary form (prematttter) [5]. Like the field, this form of matter is distinguished by its continuity (the absence of voids), which is expressed in the inequality of zero density of its density $\rho_o = dM/dV > 0$ at any point in space with the radius vector $\boldsymbol{r}$ at any time t. We will call the non-baryonic form of matter an ether-like medium, so as not to find it a priori with any of the specific models of the structure of matter.

According to the accepted opinion, this part of the matter of the Universe is unobservable (does not radiate or absorb), does not have electromagnetic properties and is characterized by "dissipativity", "fluidity", "collisionlessness" and "coldness". If we proceed from the fact that this medium is not hypothetical, then the cosmic vacuum, understood as a space free from any forms of matter, is most suitable for its role. According to modern astronomical and astrophysical data, the density of this medium is about $10^{-29} \div 10^{-35}$ g cm^{-3}. The unobservability of this medium is explained by its non-participation in electromagnetic interactions, so that out of the four known types of interaction, only gravitational interaction stays for it as a macroobject.

Another macroscopic property of the cosmic vacuum, like all ethereal-like media, is their incompressibility in the usual sense of this term as the impossibility of preserving the mass of the system M with a decrease in the volume V occupied by it ($d\rho_o/dt > 0$) only by flowing from one region of space to another with the volume of the system unchanged. This incompressibility supplies the highest speed of propagation of perturbations in the ether and similar media.

Another property of aether-like media is their infinite divisibility, which is inherent in all continuous media. Only in this case, there is a limit to the ratio of any extensive quantity Θ_i (mass M, charge Z, entropy S, impulse $\boldsymbol{P}$, its momentum $\boldsymbol{L}$, etc.) to the volume V occupied by it at $V \to 0$, called its density $\rho_i = d\Theta_i/dV$. This guarantees the applicability of the mathematical apparatus of differential and integral calculus at any point and allows us to represent the value of Θ_i as an integral of its local density $\rho_i(\boldsymbol{r}, t) = d\Theta_i/dV$ or average $\overline{\rho_i}(t) = \Theta i/V$ density $\Theta_i = \int \rho_i dV = \int \overline{\rho_i}\, dV$, whence it follows [4]:

$$\int (\rho_i - \overline{\rho_i})\, dV = 0. \qquad (1)$$

It follows that in homogeneous systems, where $\rho_i - \overline{\rho_i} = 0$ everywhere, no macro and microprocesses are possible[17]. This circumstance forces us to reconsider the existing ideas about the homogeneity and isotropy of space continuously filled with matter.

The inhomogeneity of the cosmic vacuum inevitably leads to the appearance of density fluctuations in it. If $\rho_o = \rho_o(\boldsymbol{r}, t)$, then the total change in time of this density includes convective $(\partial\rho_o/\partial\boldsymbol{r})(d\boldsymbol{r}/dt) = (\boldsymbol{v}_o \cdot \nabla)\rho$ and local $(\partial\rho_o/\partial t)_{\boldsymbol{r}}$ components:

$$d\rho_o/dt = (\partial\rho_o/\partial t)_{\boldsymbol{r}} + (\boldsymbol{v}_o \cdot \nabla)\rho_o, \qquad (2)$$

This expression is the "kinematic" equation of the wave in its so-called "single wave" approximation. [6]. This becomes more obvious if we take the value of $d\rho_o/dt$ as the “damping function” of the wave and consider the case of undamped self-oscillations of the system:

$$(\partial\rho_o/\partial\boldsymbol{r}) + \boldsymbol{v}_o^{-1}(\partial\rho_o/\partial t) = 0. \qquad (3)$$

[17] On this basis, homogeneous systems are called "internal equilibrium" in classical thermodynamics since equilibrium in it is considered as the absence of any processes.

From this expression follows the inevitability of the appearance of a standing density wave in immobile ether-like media. A feature of this wave is the limited amplitude $|\rho''-\overline{\rho}|$ of a half-wave of low density, which cannot exceed ~ $10^{-29} \div 10^{-35}$ g cm^{-3}, while the maximum value of the density ρ' is not limited. In the hydrodynamics of this kind of wave elevations), in which $|\rho'-\overline{\rho}| \gg |\rho''-\overline{\rho}|$, are characteristic of tsunamis that occur at shallow depths. This kind of single "soliton-like" compaction waves also arise in an ether-like medium (Fig. 1). They are formed due to the "flow" of the medium from a region much larger than the wavelength. In an isotropic medium, such a structure looks like a single and structurally stable (ie, soliton-like) compression wave, the amplitude of which pulsates) under conditions $\rho'-\overline{\rho}>0$ staying. The superposition of such waves forms nucleons, which later enter the nuclei of future atoms, from the simplest to the most complex. Schrödinger expressed this with all certainty, saying that "what we call particles are actually waves" [7]. For this reason, the division of matter into structured and unstructured is more general in relation to its division within the framework of the corpuscular model of the structure of matter into baryon and non-baryon.

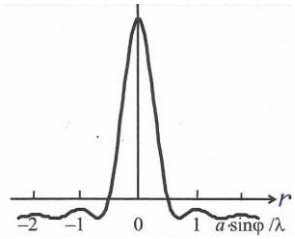


Fig.1. Standing soliton

3. The principle of proportionality of mass and energy

In matter formed by "condensation" of ether-like media, their average density $\overline{\rho}_i(t)$ is many orders of magnitude higher, so that the difference in density deviations to a large $|\rho'-\overline{\rho}|$ and the smaller side $|\rho''-\overline{\rho}|$ with their vibrations of the formed structural elements of the substance gradually disappears. In this case, the vibrations become harmonic ($|\rho'-\overline{\rho}|=|\rho''-\overline{\rho}|$). Such a wave is shown in Fig.2. By the figure, the process of wave formation is due to the transfer of some of its mass *M* from the position with the radius vector $\boldsymbol{r}'$ to the position $\boldsymbol{r}''$, i.e., the displacement of the center of mass of the wave by a half-wavelength λ. The speed of this displacement υ changes from zero at the antinode of the wave to a maximum Therefore, the process of wave formation is inextricably linked with overcoming the Newtonian forces of inertia $\boldsymbol{F} = -d\boldsymbol{P}/dt$ and with performing work on the object of their application.

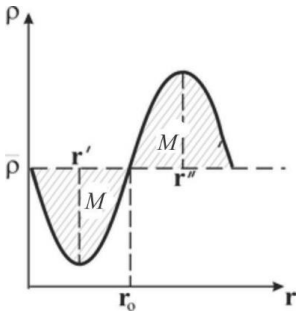


Fig.2. Wave formation in matter

$$dW = dE = \boldsymbol{F}\cdot d\boldsymbol{r} = \boldsymbol{\upsilon}\cdot d\boldsymbol{P}. \quad (4)$$

The average speed of such a reciprocating motion υ is determi-ned by the properties of the substance and is numerically equal to the propagation velocity of perturbations in it [4]. It can be found as the quotient of the mass displacement $|\boldsymbol{r}''-\boldsymbol{r}'|$, equal to the half-wavelength λ, divided by the wave period ν^{-1} with the frequency ν:

$$\upsilon = \lambda\nu. \quad (5)$$

In compaction of the matter during the condensation of the ether, this speed becomes less than the speed of light in its *c* and is connected with it by "the refractive index $n = \upsilon/c$. Therefore, in the absence of optical dispersion, when n does not depend on frequency, expression (4) can be integrated especially easily:

$$E = \int \boldsymbol{\upsilon}\cdot d\boldsymbol{P} = \int (c/n)^2 dM = M\upsilon^2 = n^{-2}Mc^2. \quad (6)$$

It is characteristic that it was in this form (although with a proportionality coefficient different from n^{-2} and changing from 0.5 to 1) that the expression (7) was obtained even before A. Einstein H. Schramm (1871); N. Umov (1873); J. Thomson (1881); O. Heaviside (1890), A. Poincare (1898); Hasenorl (1904) [8]. A. Einstein in 1905 obtained this expression because of expanding the relativistic mass into a series, limiting himself to its first two terms and assuming the speed of light in vacuum to be constant. Therefore, in no case can it be considered a generalization of expression (6), which makes the laws of conservation of mass and energy independent.

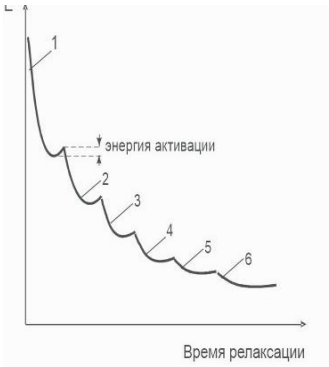
According to (6), the vibrational energy E_k of any *k*-th substance is proportional to its mass M_k only under conditions where the coefficient of proportionality $n_k^{-2}c^2$ does not depend on its structure and density. It in no way follows from it that mass can be converted into energy and vice versa, especially since these concepts are related to each other as a state function and one of its arguments,

have different meanings and different dimensions. Therefore, expression (7) can be considered only a special case of (6) for a void or a medium with physical properties independent of the state, and relation (6) is a mathematical expression for the proportionality of the energy of a substance to its mass, which is characteristic of any extensive quantity. Nevertheless, in view of the immense importance of expressions (6) and (7) for predicting the energy effect of nuclear reactions and for ease of reference, we will call them the *principle of proportionality of energy and mass.*

4. Energy balance and efficiency of the processes of substance synthesis.

The understanding of matter as a structured phase of matter makes it possible to consider "nucleosynthesis" as a process of "reification" of aether-like media. This process requires the performance of work "against equilibrium", since any wave is created due to the deviation of the oscillating value in both directions from this state. Therefore, the process of substance synthesis is fundamentally different from its "condensation" as a kind of relaxation process. The source of energy for this process is the gravitational energy of the non-equilibrium state of an inhomogeneous ether-like medium, previously converted from a gravitational form into the gravikinetic energy of oscillatory motion in it $E_k^{\upsilon} = n_k^{-2} M_k c^2$.

As experience shows, equilibrium in complex (polyvariant) systems never occurs simultaneously in all degrees of freedom inherent in it. Due to the difference in relaxation times, equilibrium is set up successively at the submicrolevel (intranuclear, intraatomic), microlevel (intramolecular, intermolecular), macrolevel (thermal, barometric, electrostatic), mesolevel (crystal lattice, massive bodies in general), and only then at the megalevel (galaxies, the universe as a whole). This is reflected in Fig. 3, which shows the "cascade of equilibria" inherent in different hierarchical levels of matter and corresponding to relaxation times. In other words, on the way to complete thermodynamic equilibrium, the system goes through many states of "partial" (partial) equilibrium, characterized by the minimum value of any type of energy. First, an equilibrium of anyone (*i*-th) kind occurs, characterized by the termination of the *i*-th process, then - an equilibrium of the *j*-th kind, etc. By experience, the system can remain in a state of partial equilibrium for an arbitrarily long time the driving force of this process Fi will not exceed some of its threshold value $\boldsymbol{F}_{io}$, i.e., the so-called "energy barrier" will not be overcome. Such a barrier exists for all forms of energy. Thus, for the implementation of thermonuclear reactions for the synthesis of light elements, it is necessary to overcome the Coulomb repulsive forces between particles, which requires an increase in temperature to a level of tens of millions of degrees; for the occurrence of a spontaneous fission reaction of heavy nuclei, an increase in the number of fast neutrons is necessary; for the implementation of chemical and biochemical reactions - the introduction of catalysts or enzymes; for a phase transition - the creation of a certain potential difference between the phases, for example, overheating or overcooling of one of the phases. Even for the beginning of the mechanical motion of bodies, it is necessary to overcome the so-called "static friction".



1 Fig.3. Cascade of partial equilibria
1.-nuclear; 2.- atomic;
3.-chemical; 4.- electric;
5.- mechanical; 6.- thermal

The reverse relaxation process is conducted during the synthesis of nuclei from nucleons or lighter chemical elements, which goes ahead from right to left on the graph in Fig. 3. However, in this case, its implementation requires the expenditure of a certain "activation energy," which stimulates a further spontaneous process of setting up a partial equilibrium of a higher order than the previous one. This "activation energy" ΔMc^2 characterizes the "mass defect" ΔM. According to this concept, the stability of any structural level is ensured by the partial equilibrium of the formed structure, for which the mass and energy of the first substances must be higher than in the vicinity of this state. However, this does not mean a violation of the laws of conservation of both energy and mass, since the "excess" mass ΔM leaves the formed structure in the form of emitted particles.

If we proceed from the laws of conservation of mass and energy, then it becomes obvious that during the "condensation" of M_o of the precursor with energy $E_o = M_o c^2$, a smaller amount M_k of the *k*-the baryon substance M_k with energy $E_k = n_k^{-2} M_k c^2$, is formed, then their difference energies E_{on} -

E_k is carried away with α, β and γ radiation, as well as with neutrino fluxes. At the same time, in accordance within addition to the *k*-the substance, in the process of condensation of the precursor, "by-products" (subnuclear particles) are also formed, which also carry away part of the mass of M_o - M_k. This is confirmed not only by the decay reactions of the nuclei of heavy elements, but also by the reactions of "cold" fusion, in which "side" chemical elements are also detected, as well as radiation of an unknown nature, leaving unusual traces in the detectors [9]. This gives rise to a special kind of irreversibility associated with the "branching" of the process trajectory in the space of variables along the set of its "directions" [10]. This kind of irreversibility should also be considered in the microcosm, where there is no energy dissipation associated with the transition of ordered forms of energy into disordered (thermal) [11]. Taking into account the "scattering" of energy associated with the formation of by-products makes it expedient to introduce the concept of efficiency of the process of "reification" of primary matter as the ratio of the energy $E_k = n_k^{-2} M_k c^2$, obtained by the target products of the synthesis reaction of the kth substance to the energy $E_{ю} = n_o^{-2} M_{ы} c^2$, given by the source:

$$\eta_k = U_K/U_o = (M_k/M_o)\,(n_o/n)^2 < 1. \quad (8)$$

According to this expression, the processes of synthesis of a medium, the refractive index of which n_k is closer to the precursor (n_o = 1), have a higher efficiency. Such a medium is the cosmic plasma, consisting of "clumps" of condensed pre-substance, which we take for free nucleons. The fact that the starting material for the formation of the nuclei of the electron shells of this plasma is the same precursor is shown by the almost identical density of the proton and electron (~ $9.71 \cdot 10^{12}$ kg m^{-3}).

On the other hand, according to (8), the process of formation of the kth substance is the more efficient, the more of this substance we get as a result of the process, i.e., the less mass loss with α, β and γ radiation, as well as with the neutrino flux and as yet unknown types of radiation. This circumstance conflicts with the concept of the mass defect ΔM_k, which is currently used to decide the energy effect of nuclear reactions. According to existing ideas, the energy effect of these reactions increases in proportion to this mass defect. Therefore, it is advisable to pay more attention to the energy balance of such reactions [12].

By (6), the specific energy εk spent on the synthesis of the *k*th substance from it is determined by the expression:

$$\varepsilon_k = (\partial U_k/\partial M_k) = v^2 = c^2/n_k^2 \text{ (J kg}^{-1}\text{)}. \quad (9)$$

This value is much greater than the specific binding energy ε_b released during the synthesis of the same substance from existing nucleons, which is decided by the mass defect ΔM:

$$\varepsilon_b = \Delta M c^2 = (Z m_p + N m_n - M_c)\, c^2, \quad (10)$$

where Z, N are the number of protons and neutrons with masses m_p and m_n, which are in the unbound state; M_c is the mass of the core.

For the helium nucleus $^4_2$He, the specific binding energy of the nucleus $\varepsilon_b \approx 7$ MeV/a. e. m., which is only a small part of the specific energy of condensation of the same amount of precursor (ε_k = 931.5 MeV/ a. e. m.). Thus, the efficiency of this process is <0.7% even at $M_k = M_o$, when $\eta_k \approx \varepsilon_b / \varepsilon_o$, i.e., it is extremely small. The processes of synthesis of a medium, the refractive index of which n_k is closer to the precursor (no), have a higher efficiency. Such a medium is the cosmic plasma, which consists of "clumps" of condensed forerunner, which, from the corpuscular point of view, we take as free nucleons. Its further compaction under the action of gravitational forces leads to the formation of gaseous substances such as hydrogen and helium, and then solid bodies, grouped into gas and dust clouds, small and large celestial bodies, galaxies, etc. Such an understanding of synthesis processes is fundamentally different from their interpretation of thermonuclear fusion as reactions accompanied by a change in energy without a change in mass, which contradicts not only the principle of their equivalence (7), but also their proportionality (6). Indeed, R. Feynman is right when he says that "our vaunted modern physics is a complete swindle" [11]. What this leads to is clearly demonstrated by the results of tests in the USSR of the hydrogen "king-bomb" in 1961 over Novaya Zemlya, when the fireball of the explosion rose into the stratosphere and burned there for half an hour, exceeding the calculated energy release by 105 times [12].

Like previously observed phenomena of the same kind, this case shows the occurrence of exothermic reactions of "burning" of the "nucleon fuel" created by nature. Such reactions are like the combustion of nuclear fuel in nuclear reactors, which go ahead spontaneously only after its "activation". In this case, such an activation was the explosion of a nuclear charge. However, even in this case, we should talk about a decrease in the mass of nucleons as the first products of the reaction, and not about their "synthesis" as an antipode to the processes of decomposition (decay) of nuclei. For the synthesis of 1 a. e. m. helium $^4_2$He from the precursor, it is necessary to condense an equal amount of it with the release of energy ε_k = 931.5 MeV / a. e. m. Of this amount of energy, only ≈ 7 MeV/ a. e. m. will be spent on the synthesis of $^4_2$He a. e. m., equal to the specific binding energy ε_b of the nucleus $^4_2$He. Such a low efficiency of this process should serve as a sobering shower for those who for the past 60 years have been promising to make mankind happy with the creation of thermonuclear reactors.

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