Review Article
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Energodynamic theory of nucleosynthesis

Abstract

A theory of nucleosynthesis processes is proposed, based on nonequilibrium thermodynamics, and allowing to reveal their specificity as processes of energy transformation. It is shown that the processes of cold and hot fusion have much in common and are impossible without the participation of an unobservable external environment, previously called ether. The validity of the laws of conservation of mass and energy for nucleosynthesis processes is proved, and the erroneousness of calculating the energy effect of nuclear reactions only based on the "mass defect", without considering the energy of the environment. The concept of nucleosynthesis efficiency is introduced and a thermodynamic interpretation of synthesis processes as a process of burning "nucleon" fuel is given. The unity of "cold" and "hot" synthesis with the processes of converting other forms of energy is revealed and facts confirming the theory are given. The extremely low thermodynamic efficiency of thermonuclear reactors as energy installations of the future is emphasized.

Keywords: matter and space vacuum, nucleosynthesis, and its efficiency, gravistatic and gravikinetic energy, hot and cold nuclear fusion, structure of the nucleus and atom

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Introduction

Currently, nucleosynthesis is interpreted as a natural process of formation of nuclei of chemical elements by fusion of elementary particles, which are in the cosmic vacuum in an "unbound" state. Three stages of this process are distinguished: primary nucleosynthesis, which occurs at the first stages of the formation of the Universe because of the "Big Bang", stellar nucleosynthesis during the combustion and explosions of stars, and nucleosynthesis under the influence of cosmic rays. At the same time, the permanent process of formation of elementary particles or chemical elements directly from the primary form of matter, previously called ether, and after its expulsion from physics "physical vacuum", "hidden mass", "dark matter", etc., is not even mentioned. The energy expenditure on the formation of the «unbound» particles is not considered in the balance of nucleosynthesis energy, as if they arose "out of nowhere" and "by themselves". There is no answer to the question of where the "secondary" elements corresponding to more complex elements than the synthesized nuclei come from in the reaction zone. It remains completely unclear why there is no radiation in the reactions of the so-called "cold" fusion, which is characteristic of any nuclear transformations, etc., etc. Meanwhile, the latest discoveries in the field of astronomy and astrophysics have convincingly shown that the Universe consists of more than 95 percent of this invisible and directly unobservable form of matter, which we will call here for brevity "subtle", "primary" matter (prematter). So as not to find it with ether as a representative of the concept of "weightless" and "indestructible" fluids long abandoned by science. Now that it has become impossible to ignore the existence of "subtle" matter, personifying the cosmic vacuum, it becomes necessary to revise the entire concept of nucleosynthesis. In this article, this will be done from the standpoint of energy dynamics as the only non-postulative theory to date of real processes of transfer and transformation of any forms of energy.[1]

Some properties of the primary form of matter

The modern paradigm of natural science divides matters into matter and field.[2] Such a division is unacceptable, if only because fields (scalar, vector, and tensor) are also present in matter. Much closer to the essence of the matter is our proposed division of matter into corpuscular (material) and continuous (subtle material), which is its primary form (prematter).[3] Like the field, this form of matter is distinguished by its continuity (absence of voids), which is expressed in the inequality of its density to zero $\rho_o = dM_o/dV_o > 0$ at any point in space at any moment in time. According to astronomical data, this part of the matter of the Universe does not have electromagnetic properties, i.e., it does not emit or absorb electromagnetic waves and is therefore unobservable.[4] Consequently, of the four known types of interaction, it is characterized only by gravitational interaction, which is manifested in its influence on the movement of celestial bodies. The most suitable medium for this role is the cosmic vacuum, understood as a space free of any forms of matter and therefore related to various phases of the subtle-material world. According to modern astrophysical data, the density of this medium is about $10^{-29} \div 10^{-35}$ g cm^{-3}. Another distinctive property of the cosmic vacuum is its "incompressibility", understood as the impossibility of reducing the volume V_o occupied by the mass M_o without changing this mass. This property is a consequence of the fact that the cosmic vacuum initially occupies all the space provided to it (i.e., it is "all-permeable"), so that it is impossible to even mentally imagine a shell in it, the compression of which would leave the mass unchanged. However, such a medium is capable of compaction, i.e., an increase in the mass M_o with an unchanged volume V_o by flowing from adjacent areas of space. Looking ahead, we note that this incompressibility ensures the highest speed of propagation of disturbances in it.

Another property of the cosmic vacuum is its infinite divisibility, expressed in the existence of a limit to the ratio of any extensive quantity Θ_i (mass M, charge Q, entropy S, impulse **P**, its momentum **L**, etc.) to the volume V it occupies when $V \to 0$. This ensures the applicability of the mathematical apparatus of differential and integral calculus at any point with radius vector r at any time t, which allows us to represent any extensive quantity Θ_i by the integral of its local $\rho_i(r, t) = d\Theta_i / dV$ or average $\bar{\rho}_i(t) = \Theta_i / V$ density $\Theta_i = \int \rho_i dV = \int \bar{\rho}_i dV$, from which follows the identity:

$$\int (\rho_i - \bar{\rho}_i)\, dV \equiv 0 \qquad (1)$$

According to (1), in homogeneous systems, where $\rho_i - \overline{\rho}_i = 0$ everywhere, no processes are possible. It is the inhomogeneity of the cosmic vacuum that leads to the occurrence of density oscillations in it. In this case $\rho_i = \rho_i(r, t)$, and its total differential includes convective $(\partial\rho_i / \partial r)(dr/dt) = (\upsilon_i \cdot \nabla)\,\rho_i$ and local $(\partial\rho_i / \partial t)r$ components:

$$d\rho_i / dt = (\partial\rho_i / \partial t)\; r + (\upsilon_i \cdot \nabla)\rho_i \qquad (2)$$

In its structure, this expression represents a "kinematic" equation of the first-order wave in its so-called "single-wave" approximation,[5] which becomes more obvious if the value $d\rho_i / dt$ is taken as the "damping function" of the wave and the case of undamped self-oscillations of the system is considered.

From this expression follows the possibility of the emergence of a standing wave of its density in a continuum medium. Due to the immutability of the sign of the gravitational force, the wave, having arisen spontaneously, causes an influx of subtle matter from adjacent areas of space. This further increases its height.

A feature of this wave in the vacuum of space is the limited amplitude of the half-wave of low density $\rho_0 < \overline{\rho}_0$, which cannot exceed the value of ~ 10-29 g cm^{-3}, while its maximum value is unlimited. This gives the wave particle-like properties. In nature, an example of such a wave is a tsunami, which occurs at a shallow depth due to the "influx" of water from adjacent areas. Such waves, as a rule, are solitary and therefore are called solutions (Figure 1). The average speed υ_o of the reciprocating motion that forms a standing wave can be found as the quotient of dividing the wavelength λ_o (the distance between adjacent antinodes) by its period (the inverse of the frequency ν), so that the modulus of this speed υ_o is equal to $\lambda_o \nu$ and is determined by the property of "mobility" of the medium. For traveling waves, its value is known as the speed of propagation of disturbances in each medium c. Such structurally stable and particle-like Solitary waves can be either standing or running, single (Figure 1) or grouped (Figure 2). Due to their anharmonicity, they transfer not only energy and momentum, but also mass, as is eloquently proved by the destruction caused by tsunamis. In stationary isotropic media, solutions appear as a local spherical compaction, which, due to the immutability of the sign of the gravitational force, attracts new masses of the environment, increasing in size and increasing the number of new shell waves. The radial and circumferential oscillations of these shells modulate oscillations of the same direction and with the same individual frequency spectrum in the environment, generating a running wave in it. The property of a charge of a certain sign is given to these shell waves by particle-like waves running in them and an external magnetic field. This (shell) model of the atom was first proposed by E. Schrödinger, who said with complete certainty that "what we call particles are in fact waves".[6] The wave model shown in Figure 3 agrees with the latest experiments, according to which electrons are scattered by atoms exactly as if they consist of concentric zones (belts) of elasticity, spaced from each other at a distance multiple of the de Broglie wavelength.[7]

The compaction of an atom with such a model requires the expenditure of a certain amount of work W by the surrounding primary matter, associated with the conversion of its gravitational energy into (potential energy of elastic deformation of these shells (vibrational). This work, according to Newtonian mechanics, is decided by the expression:

$$W = \int \upsilon \cdot d\mathbf{P} \qquad (3)$$

where υ, P are the speed and momentum of the ordered motion of the object of study.

However, in a stationary atom only oscillatory (disordered) motion is possible, the speed of which is a scalar υ_o. This speed, when the atom is compacted by increasing the number of its shells with an unchanged volume, stays unchanged under conditions of equilibrium with the environment. In this case, work (3) is called in thermodynamics "input work" (mass, charge, etc.), which increases the energy of an atom with mass M_z by the value $\Delta E_Z = \upsilon_0 \Delta M$.

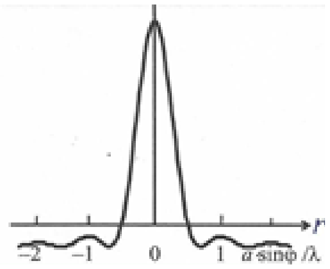

Figure 1 Standing soliton.

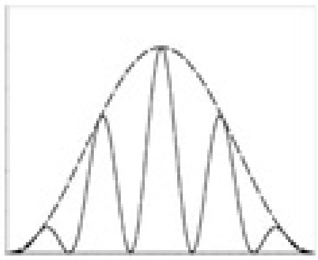

Figure 2 Group soliton.

Figure 3 Shell model of atom.

A similar work is performed when oscillations occur in a stationary cosmic vacuum, with the only difference being that the speed υo in it differs from the speed in matter, so that its integration (3) yields a value known as the "living force" of G. Leibniz:

$$E_0 = M_0 \upsilon_0^{\,2} \qquad (4)$$

It was this value that, according to the proposal of T. Young (1807), began to be called energy. The velocity of disordered (oscillatory or Brownian) motion υ_o in a substance with a refractive index n>1, which enters into expression (4), is known to be less than in incompressible media, where it is maximum and equal to the speed of light c_o, so that $\upsilon_o = c_o/n$. Therefore, for a cosmic vacuum with n =1, as well as for the ether, this oscillation energy is equal to

$$E_0 = M_0 c_0^{\,2} \qquad (5)$$

It was in this form (although with a proportionality coefficient different from n-2) that expression (5) was obtained even before A. Einstein by H. Schramm (1871); N. Umov (1873); J. Thomson (1881); O. Heaviside (1890); A. Poincaré (1898), Hasenohrl (1904).[8] A. Einstein in 1905 obtained this expression based on his theory of relativity, believing it to be independent of the nature of matter, its optical density and state. This gave him grounds to call it the "principle of equivalence of mass and energy", interpreting it as the possibility of converting mass into energy and vice versa. In contrast, expression (4) only asserts their proportionality, which allows us to consider the dependence of the speed of light in matter on its "optical density" $\upsilon_o = \upsilon_o(n)$.

The inhomogeneity of the density field ρo of the cosmic environment generates its stressed state. It is characterized by the volume gravitational force $\mathbf{X}_g = \mathbf{F}_g/V$. which, under the conditions $\upsilon_o = c_o = const$, can be found as the gradient of the local energy density of the environment $\varepsilon_0(r) = \rho_0 c_0^2$:[9]

$$Xg = (\partial\varepsilon_0/\partial r) = c_0^2\nabla\rho_0 \quad (6)$$

Unlike Newton's law of gravitation, the force F_g changes its sign depending on the sign of $\nabla\rho_0$, which gave grounds to call the law of gravitation (6) "bipolar". Like $\nabla\rho_0$, the gravitational field strength **X**g can reach arbitrarily large values. This transfers gravity to the category of the strongest interactions, making the existence of any other forces to justify the stability of the atomic nucleus unnecessary. From the bipolar law (6) it also follows that there are no gravitational forces in the antinodes of waves, where $\nabla\rho_0 = 0$. This is the reason the waves in the shell model of the atom (Figure 3) are located at a distance from the nucleus that is a multiple of the wavelength. This gives the atom stability in the absence of any other forces in the atom.[10] The latter thoroughly introduces significant adjustments to the existing model representations of classical and quantum physics.

Energy-consuming nature of cold and hot fusion processes

The use of the energy of oscillations of the cosmic vacuum $E_0 = M_0 c_0^2$ (5) in fusion processes can go ahead in two fundamentally different directions. The first of them is aimed at obtaining a certain chemical element with atomic number Z and energy $E_Z = M_Z \upsilon_Z^2$. The efficiency of this process depends on the ratio of the amount of useful substance Mz and the mass of the "materialized" fine matter Mo, which can be called the "mass" efficiency of the fusion plant. The second is aimed at releasing the "binding energy" of the constituent parts of nuclei in the form of "thermonuclear" energy, the efficiency of which is decided by the ratio of energy $E_Z = M_Z \upsilon_Z^2$ and $E_0 = M_0 c_0^2$ can be called "exergy" or "power" efficiency.[1] In this article, only this choice is analyzed, which is related to the problems of future energy.

As follows from identity (1), for it to be observed, the difference between the local ρ_i and the average density $(\rho_i - \bar{\rho}_i)$ of any extensive parameter Θ_i must have opposite signs in different elements dV of the system volume V, so that they compensate each other. This position is one of the first principles of energy dynamics, called for brevity the principle of the opposite direction of nonequilibrium processes. In its generality and significance, this principle is not inferior to the well-known dialectical law of the "unity and struggle of opposites" and can serve as its mathematical expression. In application to cold and hot fusion processes, this principle states that if nuclear fission reactions are energy-releasing, then the inverse processes of nuclear fusion must be energy-consuming.[11] The validity of this conclusion is confirmed by 60 years of unsuccessful attempts to obtain heat release in thermonuclear reactors equal with the expenditure of free energy. Even in the most encouraging experiments of this kind, recently conducted in the laboratory named after Lawrence (USA, 1922), managed to obtain only about 3.15 MJ of "thermonuclear" energy using 192 lasers, while spending about 300 MJ on their power supply.[12]

It would seem that such a conclusion contradicts the fact of the presence of a mass defect, ΔM, which is determined with great accuracy by the difference between the total mass of unbound nucleons participating in the process of synthesis of the nucleus of a new chemical element, and the mass of this nucleus:

$$\Delta M = Nm_n + Zm_p - M_Z > 0 \quad (7)$$

Where N and Z are the numbers of neutrons and protons with masses m_n and m_p in an unbound state; M_z is the mass of the nucleus. According to this expression, "free" nucleons have excess mass ΔM compared to their total value in the nucleus. From this it is concluded that they have excess energy $\Delta E = \Delta M c_0^2$, which, when they merge in the nucleus and compact it, is released in the form of "binding energy" E_z. However, when protium ^1H is formed, this "mass defect" is not present, just as there is no "binding energy". Nevertheless, it is with it that the process of "primary" nucleosynthesis begins. This means that the first of the synthesized atoms, protium 1H, arose directly from the cosmic vacuum by local compaction of particle-like waves (solitons) spontaneously arising in it. In this case, from the standpoint of the theory being developed, the first added stage in "reification" of the cosmic vacuum was the thermal (chaotic) form of motion, the release of which goes with the entire chain of subsequent complication of the atom. The "Coulomb barrier" does not exist at this stage since the electric degree of freedom arises a little later. This removes the "prohibition" on the primary "cold fusion" imposed by nuclear physics. It becomes possible to explain the emergence of not only nuclei, during the condensation of a single soliton, but also an atom during the condensation of a group soliton. In such "condensation" of one atomic mass unit (a.m.u.), 931.5 MeV of energy is released, which is incomparable with the binding energy, which does not exceed 8.8 MeV/(a.m.u.). This confirms the energy-consuming nature of nuclear fusion.[11] Other evidence is the formation of a large number of heavier chemical elements in primary synthesis, which should not yet exist at this stage of synthesis.[13] This is explained by the presence of a potential difference of the wave $(c_o^2 - \upsilon_o^2)$ between the cosmic vacuum and the substance at all stages of synthesis, which makes possible not only the sequential flow of such processes on one of the objects, but also the difference in their stages on different objects. At first, the synthesis of the substance has a low speed, since the synthesis products are nuclei of hydrogen-like gases, for which the optical density is small (n≈1), and the driving force of the synthesis $(c_o^2 - \upsilon_o^2)$ is small. At this stage, the participation of single solitons is sufficient. However, as the synthesis products are compacted, the role of molecular synthesis conducted by group solitons becomes increasingly noticeable. Catalysts and enzymes play an important role in accelerating the synthesis processes. Such catalysts are temperature and gravity. Under their influence, synthesis reactions pass to the hot stage and buy an ever-larger scale, covering small and large celestial bodies up to galaxies. The cosmic vacuum becomes the true fuel of stars, two orders of magnitude more effective than the binding energy. The fact that this is so showed by the higher temperature of the Sun's photosphere than that of the deep layers. That is why in recent centuries not only has the depletion of its thermonuclear fuel reserves not been seen, but also an increase in its temperature.

A stage on this path of accelerating synthesis processes are also “black holes” that arise in the centers of galaxies when gravity in their cores increases so much that it stops “emitting light,” turning them into a real “star factory”.[14] They stay “black” until the increase in temperature and internal pressure causes “jets” to appear in the zone of their weakened gravity (antinodes). The same thing happens with stars, in which the same processes lead to a “supernova” explosion, accompanied by a sharp increase in luminosity and a further “big gap,” which returns it to the first stage of evolution. This is how the circulation of matter and energy of the Universe is conducted, allowing it to function indefinitely, bypassing the state of equilibrium.[15] However, physicists and theoretical astrophysicists prefer not to acknowledge the existence and participation of “subtle matter” in the synthesis process, believing that the source of nucleosynthesis is high-energy cosmic particles and free nucleons formed at the initial stage of the evolution of the Universe, and in such a huge amount that it is enough for many billions of years of secondary nucleosynthesis in stars. They are not embarrassed by the fact that in this case this process is fundamentally no different from the combustion of organic or nuclear fuel, which is in blatant contradiction with the laws of dialectics.

Similarity of natural synthesis reactions and technical energy converters

The above makes it necessary to consider nucleosynthesis not as a type of chemical reactions or relaxation processes, but as a process of converting one form of energy into another, like what occurs in thermal and non-thermal machines. In this case, we are talking about the conversion of the gravikinetic energy of the primary (“latent”, “subtle”, etc.) form of matter in the cosmic vacuum into the internal (nuclear) energy of various chemical elements of the periodic table.

To prove this, we will use the energodynamic theory of the conversion of any form of energy, applicable to thermal and non-thermal, cyclic, and non-cyclic, direct, and reverse machines.[16] The main quantities that this theory runs with are the thermodynamic forces $\mathbf{X}_i$, generating any i-th process, and the flows of the energy carrier $\mathbf{J}_i$ (substance, charge, momentum, etc.), characterizing the speed of their transfer in space.

The peculiarity of this theory is the introduction of the concept of the generalized efficiency of any energy conversion unit by the ratio of the power at its output N_j and input N_i with their representation through the flows and forces of both the converted X_i, J_i and the converted energy X_j,J_j:

$$\eta_N = N_j / N_i = X_i J_i / X_i J_i \le 1 \quad (8)$$

Such efficiency, called power efficiency, is unique in that it takes into account the operating mode of the unit and the power of the energy conversion process, as well as all types of losses arising both in the process of energy supply to the unit and in the machine itself. In the specific case under consideration, the driving force of the initial (oscillatory) form of energy $\mathbf{X}_i$ and the flow of its energy carrier $\mathbf{J}_i$ can be found by considering the well-known expression for the energy density of a wave with amplitude Aν at frequency ν in a medium with density ρo:[17]

$$\rho_\varepsilon = \rho_0 A_v^2 v^2 / 2 \quad (9)$$

The total change in energy $\rho_\mathcal{E} = \rho_\mathcal{E}(\mathbf{r}, t)$ as a function of spatial coordinates (radius vector r) and time t can be represented similarly to (2) as the sum of its local $(\partial \rho_\mathcal{E} / \partial t)_r$ and convective $(\upsilon_\varepsilon \cdot \nabla)\rho_\varepsilon$ derivatives. The latter part, caused by the transfer of the wave form of energy in space, can be represented as the product of the energy carrier flow $\mathbf{J}_v$ and the driving (thermodynamic) force $\mathbf{X}_v$, as is customary in the thermodynamics of irreversible processes:[18]

$$(\upsilon_\varepsilon . \nabla)\rho_\varepsilon = -\mathrm{J}_v . \mathrm{X}_v \quad (10)$$

where $\boldsymbol{J}_v = \rho_0 A_v v \upsilon_t \left(J / m^3 \right)$ is the soliton flow, which has the meaning of the spectral density of radiation; $X_v = -\nabla(A_v v)$ – the driving force of radiant energy exchange, expressed by the negative gradient of the velocity of propagation of disturbances $\upsilon_0 = \lambda_0 v$ in a given medium. In the absence of other driving forces, this allows us to write the law of radiant energy transfer in the same form as for the processes of thermal conductivity, electrical conductivity, diffusion, viscous friction, etc.:

$$\mathrm{J}_v = \mathrm{L}_v \mathrm{X}_v \quad (11)$$

where L_v is a certain proportionality coefficient, often called the “photonic thermal conductivity coefficient.”

In an analogous way, we can find the driving force $\mathbf{X}_j$ and the flux of synthesized substance $\mathbf{J}_j$ if we describe nucleosynthesis as a type of chemical reactions. Their energy effect (work W_r in the case of reversible reactions or heat release Q_x in dissipative ones) are traditionally described in terms of the chemical affinity of the r-th chemical reaction Ar and the “degree of completion” of the reaction ξr :

$$W_r = \int A_r d\xi_r \quad (12)$$

In flow reactors, Van’t Hoff boxes, cell membranes, etc., where the parameters Ar and ξr depend on the spatial coordinate r of the cross-section of the chemical reactor, these reactions acquire a directed (vector) character, which also allows us to introduce the concept of the flow of reagents Jr participating in the r-th chemical reaction, and the thermodynamic force of the reaction $X_r = -\nabla(A_r \xi_r)$ as an “antigradient” of the local chemical affinity of the r-th chemical reaction $A_r \xi_r$ in a given cross-section of the flow reactor. In this case, the power of the r-th chemical reaction dW_r/dt can also be expressed as the product of the driving force $\mathbf{X}_r$ and the flow of reagents $\mathbf{J}_r$, and this flow itself can be expressed in the same form as the above-mentioned transfer processes:[19]

$$J_r = L_r X_r \quad (13)$$

In energy conversion devices, where the flows of energy carriers of both the converted, $\mathbf{J}_v$, and the transformed form of energy $\mathbf{J}_r$ flow simultaneously, they become interconnected. This interconnection is expressed in the fact that each of them becomes dependent on both forces and $\mathbf{X}_v$ so that the laws of energy conversion buy a matrix form:[20]

$$X_v = R_{vv} J_v - R_{vr} J_r \quad (14)$$

$$X_v = R_{rv} J_v - R_{rr} J_r \quad (15)$$

where the “diagonal” R_{vv} , R_{rr} and “cross” R_{vr}, R_{rv} proportionality coefficients characterize the resistance to the flow of energy carrier from the side of the “same” and “foreign” forces, respectively. If these coefficients are considered independent of the flows, i.e., if equations (14), (15) are considered in a linear approximation, then they can be presented in the dimensionless form.

$$X_v / X_{v0} + J_r / J_{\mathrm{pk}} = 1 \quad (16)$$

where X_v/X_{vo} is the ratio of the driving forces of the radiant energy exchange process in the current mode and the isolation mode; $J_r/J_{rк}$ is the ratio of the reagent flows in the current mode and the maximum reactor productivity mode.

This form of phenomenological laws (14), (15) emphasizes the unity of the processes of transformation of any forms of energy. It can be presented in an even more compact form if the coefficients included in the equations are combined into the criterion of its "constructiveness" $\Phi = R_{vr}R_{rv}/R_{w}R_{rr}$, similar in meaning to the ratio of "reactive" resistances of an electric circuit to active ones, and in equation (15) the criterion of the degree of loading of the installation $B = 1 - X_V/X_{VO}$, is introduced, characterizing the degree of its approach to the mode with the maximum yield of nucleosynthesis products, similar to the "short circuit" mode in the machine load.

Using these generalized criteria, it is possible to construct universal dependencies of the efficiencies of linear energy converters, shown in Figure 4.[21]

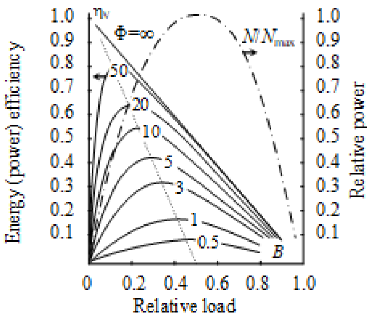

Figure 4 Universal load characteristics of linear systems.

Their main feature is that the power (and in particular, exergy) efficiency of any real energy converter goes to zero twice: at idle (B = 0), i.e., in the absence of a useful product output, and in the "short circuit" mode (B =1), i.e., in this case, when all the supplied energy is dissipated. Thus, the dependence of the efficiency of any real installation $(\Phi < \infty)$ has the character of an asymmetric bell-shaped curve, which has an increasingly pronounced maximum with an increase in Φ. At the same time, the modes with maximum efficiency and maximum power (dash-dotted line) also diverge more. This significantly complements the results of the analysis of the efficiency of power plants of several types and brings them closer to reality.

The above has the most direct relation to cold and hot nuclear fusion installations, revealing their fundamental unity despite different design versions. As is known, their thermal power is decided by the mass defect proportional to the binding energy $\varepsilon_z = dE_z / dM$, which at its maximum reaches 8.8 MeV/(a.m.u.). This energy is the useful product of thermonuclear reactions. The energy supplied from the source $\varepsilon_0 = dE_0/dM_0 = c_0^2$ is expressed by the value of 931.5 MeV/(a.m.u.). Unbound nucleons have the same energy, if they are considered as the source of the primary (converted) form of energy. Therefore, the ratio

$$\eta_s = \varepsilon_z/\varepsilon_0 \ll 1 \qquad (17)$$

Discussion

Numerically equal to the power efficiency η_N, does not exceed ~0.86% for them. A close efficiency value (slightly higher than 1%) was also found by the above-mentioned Lawrence Laboratory.[12] In addition, the nature of the experimental curve of the dependence of the specific binding energy εz on the number of nucleons in the nucleus, cited in all physical encyclopedias, also attracts attention; it also vanishes in the "idle" mode and has the form of an asymmetric bell-shaped curve. Both circumstances confirm the validity of the energy-dynamic theory of nucleosynthesis and show the extreme inefficiency of thermonuclear fusion plants.

Conclusion

This circumstance should be considered by those who have been promising to make humanity happy with cheap and environmentally friendly "thermonuclear fusion" for several decades. At the same time, the energodynamic theory of nucleosynthesis clearly points to the cosmological vacuum as the true source of stellar energy, not only exceeding the power of "thermonuclear fuel" by two orders of magnitude, but also in principle inexhaustible due to the circulation of matter and energy in the Universe, contrary to the notorious concept of its birth as a result of the "Big Bang". In this regard, the results of the tests of the hydrogen "Tsar Bomb" in the USSR in 1961 over "Novaya Zemlya" are very indicative, 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.[22] The latter circumstance convincingly testifies to the consumption of energy from the environment in the long "burning" process that followed the initiation of thermonuclear fusion, to the erroneous calculation of heat release based on the mass defect and to the complete misunderstanding of the mechanism of this process by theoretical physicists.

Acknowledgments

None.

Conflicts of interest

The authors declare that there is no conflict of interest.

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