MedCrave
Step into the World of Research

Aeronautics and Aerospace Open Access Journal

Research Article

Open Access

CrossMark

To the energodynamics of universe

Abstract

It is proposed to consider the processes of the evolution of the Universe from the standpoint of energodynamics as a unified theory of the power of processes of energy transfer and transformation in isolated systems. Within the framework of this theory, an equation of the Universe was obtained, covering all categories of processes occurring in it, and a new law of gravity applicable to the cosmic vacuum. This law predicts the existence of gravitational forces of attraction and repulsion, gravitational equilibrium and "supergravity," which allows the universe to function forever without being in equilibrium. The theory explains the nature of the evolution of the Universe, which is incompatible with thermodynamics, and a number of mysteries of its behavior, including the flow of matter from galaxy to galaxy, libration, the anomalous behavior of "space probes", the observed nature of the rotational curves of galaxies, the existence of "gravitational wells", the size of its "black holes", revealing their role as "factories" of matter in it. Data from astronomical observations confirming the validity of the theory are presented.

Keywords: universe, evolution, baryonic and non-baryonic matter, attractive and repulsive forces, gravitational equilibrium, strong and weak gravity, observational data

Volume 8 Issue 3 - 2024

Etkin VA
Togliatti State University (RF), Israel

Correspondence: Etkin VA, Institute of Integrative Research, Israel, Tel 9720547595285, Email etkin.v@mail.ru

Received: June 28, 2024 | **Published:** July 11, 2024

Introduction

One of the most fundamental achievements in astrophysics of the twentieth century was the reliable establishment of the fact that at least 95% of the mass of the Universe is a "dark" (unobservable) field medium.[1,2] It follows that modern science has so far studied no more than 5% of the matter of the Universe, nevertheless extending to it the laws set up by thermodynamics for ordinary (observable) matter.[3] And this was done even though the state of thermal equilibrium, fundamental to thermodynamics, had not been set up in the Universe for at least the 14.7 billion years that the "Standard Cosmological Model" allotted to it. Thus, extrapolation of classical thermodynamics beyond the strict limits of applicability of its original concepts of quasi-static equilibrium and reversibility is allowed.[3] Meanwhile, it is obvious that the Universe as a whole, which includes the complete set of interacting (mutually moving) material objects, which do not always have a thermal form of energy, is not a "thermodynamic" system. Therefore, the application of the concepts and methods of classical (equilibrium) thermodynamics to the Universe as a whole, up to the description of the properties of its "black holes," is an attempt with obviously unsuitable means. The latter concerns not only the "theory of thermal death of the Universe," but also the use of the concept of entropy in relation to "dark matter" and "black holes," the properties of which are different from ordinary matter. More interesting is the consideration of processes in the Universe from the standpoint of a more general and non-hypothetical theory of the power of energy transfer and transformation processes, called "energodynamics".[4] This is the purpose of this article.

Methodological features of energodynamics

Unlike classical thermodynamics, energodynamics recognizes from the very beginning that any macroscopic processes occur only in the absence of internal equilibrium (spatial homogeneity) in the object of study (system). This can be proven using a very simple theorem, representing any macroscopic parameter of the system Θ_i (its mass M, the number of moles of the kth substance N_k, entropy S, charge $\Theta_{\hat{a}}$, impulse P, its moment L, etc.) by the integral $\Theta_i = \int \rho_i dV = \int \overline{\rho}_i dV$ from its local $\rho_i = d\Theta_i / dV$ and average $\overline{\rho}_i = \Theta_i / V$ density. Comparing these two representations, we find:

$$\int [(d(\rho_i - \overline{\rho}_i) / dt] dV = 0 \quad (1)$$

The turning of integral (1) to zero means that in homogeneous systems, where the difference ρi is equal to zero everywhere, no processes are possible, which is what needed to be proven. Moreover, according to (1), the speed $d(\rho_i - \overline{\rho}_i) / dt$ of any of the processes occurring in the system has the opposite sign in different elements dV of volume V of the system. This shows the opposite direction of processes in various parts (regions, phases, components) of heterogeneous (internally nonequilibrium) systems. The latter position can be considered as a mathematical expression of the dialectical law of "unity and struggle of opposites" and serve as the basis for energodynamics as a more general scientific discipline, from which nonequilibrium thermodynamics and other fundamental disciplines follow as a special case.

Like classical thermodynamics,[3] the mathematical apparatus of energodynamics is based on the properties of the total differential of a number of generalized functions of the state of the system as a whole type of its internal energy U, enthalpy H, etc. However, now they consider the spatial heterogeneity of the system, leading to the uneven distribution of any energy carrier Θ_i over the volume of the system V. This density heterogeneity is characteristic of all levels of the universe, including the Universe as a whole. Otherwise, it is impossible to explain the well-known phenomenon of one galaxy passing through another. As a result of this heterogeneity, the energy carrier density ρi becomes a function not only of time t, but also of spatial coordinates, i.e., the radius vector r of a point in its field, i.e., $\rho_i = \rho_i(\mathbf{r}, t)$.

A measure of this heterogeneity can be the deviation of the center Ri of the energy carrier value Θi from its position in the homogeneous state R_{io} =0, which is decided in a known way:

$$R_i = \Theta_{ii}^{-1} \int \rho_i r dV; \; R_i = \Theta^{-1} \int r dV \quad (2)$$

where r is the running (Eulerian) spatial coordinate.

It follows that when the system deviates from a homogeneous ("internally equilibrium") state, a certain "moment of distribution" of the energy carrier arises:

$$Z_i = \Theta_i(R_i - R_{ri}) = \int(\rho - \bar{\rho})rdV \quad (3)$$

with the shoulder $R_i - R_i$, which we called the "displacement vector".[4] If the system is motionless, $R_i = 0$ can be taken as the origin of its reference and the total differential of the parameter $\mathbf{Z}_i = \Theta_i \mathbf{R}_i$ can be decomposed into three independent components:

$$dZ_i = R_i d\Theta_i + \Theta_i dr_i + d\varphi_i \times Z_i, \quad (4)$$

where φ_i is the Euler angle of the vector Z_i; dr_i – shear part $dR_i\,(\text{at}\,\varphi_i = \text{const})$

These three components correspond to three independent categories of nonequilibrium processes: the input of energy carrier Θ_i into the system, its redistribution throughout its volume and the reorientation of the vector Z_i in space (including its rotation). As a result, any i-th form of internal energy of the system U_i becomes a function in the general case of three independent parameters: $U_i = U_i(\Theta_i, \ddot{\eta}, \ _i)$. In this case, the total differential dU of the internal energy of the system U = Σi Ui as the sum of the partial energies of all its forms (i = 1,2, I) can be represented as the identity:

$$dU \equiv \Sigma_i \Psi_i d\Theta_i + \Sigma_i F_i \cdot dr_i + \Sigma_i M_i \cdot d\varphi_i, \quad (5)$$

where $\Psi_i \equiv (\partial U_i / \partial \Theta_i)$ – generalized potentials ψ_i averaged over the volume of the system (absolute temperature T and pressure p, chemical potential of the kth component of the system μk, its electric φ, gravitational ψg, etc. potential); $F_i \equiv (\partial U_i / \partial r_i)$ – generalized forces (external and internal, mechanical and non-mechanical, useful and dissipative); $M_i \equiv (\partial U / \partial \varphi_i)$ – moments of these forces.

Identity (5), which is the result of the joint determination of the "conjugate" parameters Ψi and Θi, Fi and ri, Mi and φi, is applicable both for the system as a whole and for any part of it (region, phase, or component). In homogeneous systems, where Fi =0, the 2nd and 3rd sums of identity[5] vanish, and it goes into the combined equation of the 1st and 2nd principles of classical thermodynamics in the form of the generalized Gibbs relation,[6] which describes the processes of external energy exchange of the system (heat exchange, mass transfer, diffusion, volumetric deformation, etc.). This is how the synthesis of equilibrium and nonequilibrium thermodynamics with other fundamental disciplines running with the concept of force is conducted.[3] At the same time, identity (5) as a strengthened equality stays valid when non-static processes occur in the system. This solves the well-known problem of thermodynamic inequalities and allows us to reflect the kinetics of real processes by the relation:

$$dU/dt \equiv \Sigma_i \Psi_i d\Theta_i/dt + \Sigma_i X_i J_i + \Sigma_i M_i \omega_i \quad (6)$$

where $X_i = -F_i/\Theta_i$ – force field strengths, called thermodynamic forces in the theory of irreversible processes (TIP) []; $Ji = dZ_i / dt$ - energy flow $\Theta_i; \omega_i = d\varphi_i / dt$ – angular velocities of the vector Z_i.

Equation of the universe

Identity (6) characterizes the power of processes occurring in systems with any finite number of degrees of freedom and expresses it depending on the rate of change of system parameters Θ_i, r_i and φ_i, regardless of what caused their change - external energy exchange or internal (including dissipative) processes. This becomes more obvious if we represent the derivative dΘi/dt in the form of two terms, one of which $d_e\Theta i / dt = -\int j_i \cdot df$ is expressed as an integral of the density $ji = dJi / dV$ of the flow Ji through the vector element df of the system surface, and the other $d_u\Theta_i / dt = -\int(\partial \rho_i / \partial t)rdV$ is represented by the integral over the constant volume of the system V of the density of the internal source (∂ρi/∂t)r of the value Θi. Then it becomes clear that with an increase in the volume of the system and an increase in the V/f ratio, the role of external energy exchange processes weakens and at V/f becomes negligible. This means that the Universe should be considered as an isolated system, even considering gravitational forces. This allows us to give this law of conservation of internal energy dU/dt =0. meaningful form, entirely expressed through measurable parameters:

$$dU/dt \equiv \Sigma_i \Psi_i d\Theta_i/dt + \Sigma_i X_i J_i + \Sigma_i M_i \omega_i = 0 \quad (7)$$

This expression can rightfully be called the equation of the Universe, since it describes all categories of processes occurring in it, including the emergence of new degrees of freedom and forms of energy in it, its redistribution between regions, phases and components of the system, their translational, rotational and oscillatory motion, etc. All these processes have their own driving forces and speeds, and their relationship is expressed by the law of conservation of energy (7). Such a general expression of this law is not used by any of the known fundamental disciplines, from the mechanics of a point to the hydro and electrodynamics of continuous media, since they either exclude from consideration the internal processes in the bodies or particles under study, or split the system into volume elements in which such processes can be neglected. This makes them incapable of studying isolated systems for which all processes, all forces and all forms of energy are internal. In this regard, energodynamics is an exception, since it allows the study of internal processes at any hierarchical level of the universe that can be described using parameters. For her, all processes described by identity[7] are internal, and the hidden mass (ether) is the original (and therefore indispensable) part of any material system, from which all types of baryonic matter arose in the process of evolution. In this case, force fields are considered not as a substance, but as a property generated by the uneven distribution of the corresponding material energy carrier in space. In particular, the uneven distribution of hidden mass, which is not involved in electromagnetic interactions, generates gravitational fields and forces as gradients of this field. Thus, energodynamics is an indispensable tool for analyzing processes in isolated systems such as the Universe as a whole.

Energy of the observable and unobservable (dark) mass of the Universe

An immediate consequence of the spatial heterogeneity of the Universe and any part of it (region, phase, part) in which any processes occur is the inevitability of the occurrence of oscillatory motion. Indeed, if the cosmic vacuum density ρ_o is a function of spatial coordinates and time, i.e. $\rho_0 = \rho_0(r, t)$, its total time derivative $d\rho_0/dt$ includes local $(\partial \rho o / \partial t)r$ and convective $(\partial \rho_0 / \partial r)(dr/dt) = (\upsilon_0 \nabla)\rho_0$ component:

$$d\rho_0/dt = (\partial \rho_0 / \partial t)_r = (\upsilon_0 \nabla)\rho_0 \quad (8)$$

This expression has the form of a "kinematic" wave equation, in which dρo/dt plays the role of the "damping function" of the wave," which is especially obvious for undamped waves.

$(d\rho_0/dt = 0)$:[6]

$$\upsilon_0^{-1}(\partial \rho_0 / \partial t) + (\partial \rho_0 / \partial r) = 0 \quad (9)$$

In contrast to the "dynamic" wave equation (2nd order), such a wave with $d\rho_0/dt \neq 0$ propagates from the disturbance source in one direction.[6] The disturbing factor for the appearance of such a traveling gravitational compaction wave, similar to an acoustic one,

is the merger of galaxies or "supernova" explosions in outer space. The energy of these oscillations is known as the "living force" of G. Leibniz U = Mυo2, which, even with the speed of propagation of disturbances in the cosmic vacuum equal to the speed of light c, amounts to:

$$U=M_0c^2 \tag{10}$$

This expression of energy was found for the ether by a number of researchers[5] even before A. Einstein, who obtained it for the total energy E as a consequence of the expansion of the "relativistic" mass Mrel into a series in velocity v, retaining only the first two terms of this series.[8] Meanwhile, as follows from the above, this quantity has the meaning of the energy of the disordered oscillatory motion of a substance called ether by R. Descartes. For an isolated system, it does not depend on the movement or position of its center of mass, i.e., it is internal. Thus, one of the consequences of the uneven distribution of the density of the hidden mass of the Universe is the inevitable occurrence of oscillations in at least some part of it involved in the oscillatory motion. This explains the low proportion of observable matter in the Universe, estimated at 4.9%. By its nature, it stays gravitational since other known types of interaction in the "hidden" mass of the Universe have not been discovered. However, the occurrence of oscillations means the transition of some part of the gravistatic (potential) energy into "gravidynamic" (kinetic). The latter is easily convertible into any other form of energy Ui, which decides their emergence as this "hidden" mass becomes denser and its "condensation" ("materialization"). This is the internal kinetic energy Uk of diffusion and relative rotation of the macroscopic masses of the system (translational Uw and rotational Uω). The other part forms stable structures and becomes potential Ur. The rest stays disordered and can be called internal thermal energy Uq). This corresponds to the law of conservation of energy of the Universe in the form:

$$dU = dU^w + dU^{\omega +} dU^r + dU_q = 0 \tag{11}$$

This energy balance equation is different in that it does not have external energy components, which for isolated systems is meaningless. This makes the law of conservation of energy independent of the external energy gauge, at which potential energy becomes negative and exactly equal to kinetic energy. This cuts the situation in which the Universe arises "out of nothing",[9] and "modern physics does not know what energy is".[10]

Bipolar law of gravity in the hidden mass of the Universe

Let us now use the principle of proportionality of mass and energy (10) to derive the law of gravity for the field form of matter, in which neither "field-forming" nor "test" masses can be distinguished. Since for field quantities it is more convenient to relate all extensive quantities to a system of unit volume, we will run with the concept of gravitational field energy density $=dU/dV=\rho c^2 \left(J/m^3 \right)$. It follows that the local potential of the gravitational field is $\Psi_g = dU/dM = d\rho_g/d\rho = c^2$. Then, by analogy with the concept of electric and magnetic field strength, it is proper to introduce the concept of gravitational field strength $X_g = \rho g$. At c = const, it is expressed through the substance density gradient $\nabla\rho$ by a simple relation:[11]

$$X_g = c^2\nabla\rho,\ g = c^2\nabla\rho/\rho \tag{12}$$

By this law, gravitational forces can have different signs depending on the sign of the density gradient Äñ. That is why we called it the bipolar law of gravity. Where $\left(\partial U/\partial r\right) < 0$, i.e., in the direction of decreasing density, these forces have the character of "attractive" forces, as in Newton's law. Where $\left(\partial U/\partial r\right) > 0$, i.e., in a zone of low density such as "voids" (regions of space free from celestial bodies), gravitational forces look like "pushing" forces. They create the effect of "expansion" Universe," although it already occupies all the space and has nowhere to "expand." It is just that galaxies, under the influence of gravitational forces, become denser, giving way to voids, which looks like their "scattering."

It is easy to show that Newton's law of gravitation can also be given the form (12) if we take a unit volume of the cosmic medium with a non-uniform density ρ as a "field-forming body" with mass M = ρV. Then, by Newton's law, its gravitational potential will be equal to $\psi_g = -\left(GV/R\right)\rho$, and the acceleration $g = -\nabla\psi g$ will take the form:

$$g = -\nabla\psi_g = -\left(GV/R\right)\nabla\rho = \psi_g\nabla\rho/\rho, \tag{13}$$

which is equivalent to (12), since $\psi_g = c^2$. Consequently, Newton's law should be considered as a special case of the more general law of gravitational interaction, when only the interaction of only two bodies from their complete set is considered.

From the law of gravity (12) follows a number of fundamentally new and important consequences of the energy-dynamic theory of gravity, which we will touch on below.

Gravity as the "fuel of the Universe" and the driving force of its evolution

The main consequence of the bipolar law of gravity (12) is the recognition of gravitational interaction as universal and the strongest known to science. All other types of interaction are exceptional cases of gravitational interaction and are weaker due to υ < c. This makes it unnecessary to postulate the existence of some special "strong interaction" that holds together the nucleons of the nuclei of chemical elements. This opens a direct path to the creation of the "unified field" theory.[12]

It is equally important that the energy $u_g = c^2$ released during the condensation of a unit of latent mass of Mo is equal to 931.5 MeV/amu, while the binding energy of nucleons in the nucleus εn, determined by the "mass defect" ΔMo, almost two orders of magnitude less. The latter means that it is the gravidynamic energy of condensation of nonbaryonic matter that is the main "fuel" of stars. It is no coincidence that the temperature of the solar photosphere, where this process takes place, exceeds that of its surface. This makes gravity the "driving force" of the process of evolution of the material phase of matter in the Universe - the appearance of new properties in it, the synthesis of atoms and their compounds, the birth of small and large celestial bodies and the formation of galaxies. This evolution is directed against equilibrium and therefore is impossible without performing work W, on the substance, which makes the processes of hot and cold synthesis of chemical elements energy-consuming.[13]

This (dialectical) nature of the development of the Universe directly follows from identity (1) and makes it necessary for it to have an antipode of matter that changes its state in the opposite way in this process. Such an antipode, as shown above, is the field medium, which is currently unfortunately called "field", but in reality represents an unstructured (continuum) form of matter, previously called ether, and after its expulsion from physics - "hidden mass", "physical vacuum", "dark matter", etc. In this regard, the term "non-baryonic matter" or

"cosmic vacuum" used here is preferable since it shows an existing medium with certain properties.

To follow the stages of the process of "reification" of this unstructured (non-baryonic) matter, let us imagine that in some region of the field medium with a non-uniform density $\rho_o = \rho_o$ (r, t) spontaneously arose at least a slight local compaction ($\partial\rho o/\partial t)r > 0$). Then, by the law of gravity (12) and by expression (8), an influx of field medium to it from the outside occurs. Since the sign of $\nabla\rho < 0$ stays unchanged, this compaction process continues after the density of the medium reaches the condensation threshold, and a process occurs in it, accompanied by the formation of a structured substance with certain properties and boundaries. To reveal the specifics of this structure formation process, we use the law of conservation of mass $M = \int\rho dV = V = \text{const}$. Dividing the volume V into two parts V' and V" with density ρ' > and ρ" < , respectively, based on the law of conservation of mass we have:

$$dM/dt = \int d(\rho'-)/dt)\, dV' + \int d(\rho''-)/dt)\, dV'' = 0 \qquad (14)$$

In accordance with (14), densification processes in one part of the Universe $d(\rho'-)/dt > 0$ are inevitably accompanied by decompression processes in others $d(\rho''-)/dt < 0$. If the density of non-baryonic matter is low, and $|\rho''-| \ll |\rho'-|$, a compaction wave of "elevation" appears, called a soliton. In hydrodynamics, such a wave occurs at shallow depths and is known as a tsunami. In an isotropic field environment, such a structure looks like a group solution (Figure 1), reminiscent of the Schrödinger model of the atom.[14] In this model, less dense shells are grouped around the central, most dense core, which are found at a distance from the center of the core, a multiple of the wavelength, like spherical electron clouds. The number of such spherical shell waves increases with increasing core mass. This model is supported by experiments showing that electrons in an atom behave as if they form elastic multilayer spherical shells around the nucleus.[15] This (wave) concept of the structure of matter was first put forward by D. Jeans, who suggested that "in the world there are waves and only waves: closed waves, which we call matter, and open waves, which we call radiation or light".[16] This was said even more definitely by E. Schrödinger, who argued that "what we now consider to be particles are actually waves".[14] This concept opens a completely different view of the physics of condensed matter.

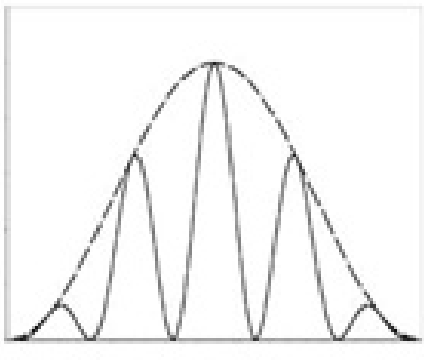

Figure 1 Group solution.

Evolution of the universe from the perspective of energodynamics

The general relativity equations describe a homogeneous Universe "as a whole" without considering the opposite direction of processes in its individual regions and therefore cannot correspond to the real situation. The presence of a constantly operating driving force of the evolution of the Universe in the form of a potential difference between the non-baryonic and baryon phases of the matter of the Universe $c^2 - v^2$ makes obvious the circulation of matter and energy in it[17] contrary to the hypothesis of the "big bang" and its emergence "out of nothing".[9] In general terms, this circulation process looks like this: wave solution-like structures that arise in non-baryonic matter are capable of densification, which is expressed in an increase in the number of solutions per unit volume of space. As a result, a substance is born as a type of matter that has a certain structure and boundaries. The features of its structure make the spectrum of their oscillations discrete and unique (individual), which makes it distinguishable from the background spectrum of oscillations of field environments. This process of "reification" requires the expenditure of a certain amount of work, described by the 2nd and 3rd sums (6) and covers all levels of the universe, starting with nucleosynthesis and ending with the formation of galaxy clusters. The evolution process ends when the internal pressure forces in stars, which increase as the stars heat up, become dominant over the gravitational forces, which, on the contrary, weaken as their density ρ increases and the relative gradient $\nabla\rho/\rho$ decreases. Then a "supernova explosion" occurs, accompanied by a "big break" and the return of their matter to its original field (unstructured) state. This is how the "machineless" transformation of energy and the circulation of matter in the Universe are conducted, allowing it to function indefinitely, bypassing the state of equilibrium.[18] This conclusion is fundamentally at odds with the hypothesis of the emergence of the Universe from a cosmological singularity, i.e. a state with infinite density and temperature, where all the laws of physics known to us cease to apply, and according to Hawking, all our ideas about time and space lose their validity.

Testable theory predictions

The energodynamic theory of gravity is based on firmly set up theoretical principles and is free from any hypotheses and postulates. Therefore, it is not surprising that she finds confirmation in many of her predictions.

The existence of "gravity pits"

It is known that the forces of attraction of the Moon to the Sun, calculated according to Newton's law, are more than twice the forces of its attraction to the Earth. However, the Moon never leaves its orbit around the Earth. The bipolar law of gravity (12) brings clarity to this issue, according to which the direction of the local gravitational force is determined by the density gradient of the cosmic vacuum in the zone where the celestial body is located, and not by the distance to any of the "gravitating" celestial bodies. This gradient can change its sign depending on the density distribution in each region of space.

Let us have two neighboring clusters of celestial bodies, the density of which ρ=ρ(r,t) decreases towards the periphery in the form of a bell-shaped curve (Figure 2, upper half). These clusters are like a giant group soliton, which are separated from each other at a distance nλ, a multiple of the soliton wavelength λ. In general, they have different maximum densities (it is higher in the left cluster). The fact that the forces arising in this case have the character of gravitational forces (Xg <0) immediately follows from law (12) as a result of a decrease in the density of star clusters (dρ <0) with distance from its center (dr>0). It also follows from it that in the region of the cluster's antinode, where dρ = 0, gravitational forces are equal to zero (Figure 2, lower part). They are also equal to zero in a certain region around the galaxy, where dρ =0. On the contrary, where the steepness of the front of the envelop pe density curve ρ(r,t) is maximum, the forces Xg are also maximum. As a result, in the region of space occupied by the galaxy, a "gravitational hole" is formed, into which surrounding

bodies seem to "fall." For clarity, this "pit" is shown in Fig. 2 in an "overturned" form with respect to the g gravitational forces Fg. In fact, these are areas of increased gravity, which become "black holes" at a certain stage in the evolution of certain stellar generations. As a result, the "supergravity" regions take the form of a double-humped curve (the lower half of Figure 2), the maxima of which correspond to the region of the greatest "steepness" of the cluster density curve front. For a three-dimensional soliton, which is a local spherical compaction of the cosmic medium, this "hole" has the form of a concentric elevation with a dip in the center. This explains why "jets" arise precisely in the center of the core of galaxies, where gravitational forces are minimal. The presence of such "holes" (more precisely, areas of enhanced gravity) explains the existence of massive bodies of their own "zone of gravity," and within which the attraction of other bodies is excluded. This explains the stability of the orbit of the Moon, located in this zone. The existence of the same "hole" near the Sun explains both the slowdown of the Pioneer space probes as they approach the "Kuiper belt" (i.e., the edge of the "hole"), and the lack of "own" gravity in small celestial bodies that are not capable of change the sign of the space density gradient. This explains the unsuccessful attempts to "land" spacecraft on their surface due to their "own" gravity, predicted by Newton's law of gravity.

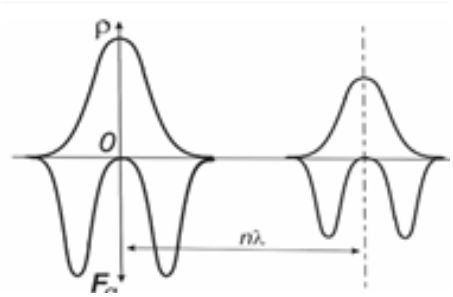

Figure 2 Density curves of two galaxies and their gravitational wells (above and below the x-axis).

Non-Newtonian character of rotational curves of galaxies

One of the most important predictions of the energy dynamic theory concerns the nature of the rotation curves (Fig. 8), which, according to Newtonian solid mechanics, should have the form of a dotted curve A. However, observations of numerous rotating galaxies have shown that the actual nature of the rotation curves is closer to the red curve B. The reasons for these discrepancies are not difficult to find if the law of gravity (14) considers the spatial inhomogeneity of the distribution of matter in spiral galaxies. In this case, the equality of gravitational forces $g = \psi_g \nabla\rho/\rho = c^2\nabla\rho/\rho$ and centrifugal acceleration forces $gc = \upsilon^2/r$ leads to the relation:

$$(\nabla\rho/\rho)r = -(\upsilon/c)^2 \qquad (15)$$

According to this expression, the rotation speed of the peripheral layers of galaxies υ/c can remain constant if the relative gradient of matter density in them $\Delta\rho/\rho$ decreases towards the periphery in inverse proportion to its radius.

Wave formation in outer space

According to equation (8) and Figure 3, in a space with inhomogeneous density, ordinary acoustic (longitudinal) density waves of the cosmic vacuum inevitably arise. They become visible since these waves have a soliton-like structure ("elevation" waves like a tsunami) and therefore transfer not only energy and momentum, but also mass, entraining interstellar matter along the way. The largest waves of this kind arise during collisions of galaxies and, according to astronomical observations, are detected by an enhanced glow in the region of the shock wave front at distances of over 250 million light years (Figure 4). They were discovered by the LIGO collaboration, since the principle of operation of their interferometer was based precisely on the short-term approach of freely suspended reflectors found at a considerable distance (i.e., designed for long wavelengths). In any case, the assumption about the connection of these waves with distortions of the space-time metric does not follow from the known physical laws, as well as the connection of this metric with ordinary gravitational forces.

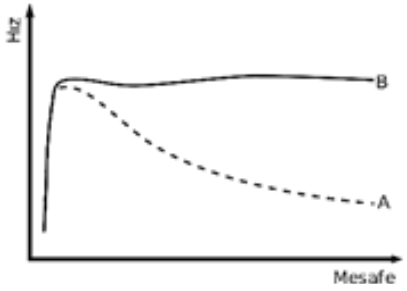

Figure 3 Galaxy rotation curves.

(Source – Wikipedia)

Figure 4 Shock waves from galaxy mergers.

(Source – Wikipedia)

The existence of "gravitational repulsion"

As follows from the law of gravity (12), in the region of reduced wave density ($\rho <$) gravitational forces act in the direction of "smoothing" the wave, i.e., increasing its length λ. This means that the region of low density tends to expand, causing star clusters to move away from each other (galaxy recession). This decides the fact, well known to astronomers, of the existence of so-called "voids" - cosmic voids of enormous size (over a billion light years), free from celestial bodies. One of the largest of them, the Bootes void, is shown in a NASA photograph (Figure 5). Energodynamics explains the absence of celestial bodies in voids precisely by the low density of hidden mass in them (from ~10-27 to ~10-34 g cm-3), which is clearly not enough for the process of its condensation to occur.

Figure 5 Void Wolopas.

(Source – Wikipedia)

Existence of gravitational equilibrium

Astronomers often see cases when stars, which, due to Newton's law of gravity, should be grouped at the center of the galaxy, on the contrary, are found at a considerable distance from it and form ring structures, as shown in Figure 6. It looks as if there are gravitational "repulsion" forces acting between them. However, such structures turn out to be very stable and show no tendency either to move away or to move closer together. The solution follows from the existence of a stable gravitational equilibrium corresponding to the condition $\Delta\rho=0$. Such conditions are typical for wave structures in the region of increased density ($\rho>$) when gravitational forces are aimed at reducing the wavelength and increasing its amplitude on Figure 1. In this case, gravitational forces are absent at the antinode of the compression wave, which decides the stable location of star clusters at distances that are multiples of the wavelength. This also implies a difference in the sign of $\nabla\rho$ on both sides of the antinode, i.e., the existence of "gravitational funnels" delimiting the areas of attraction of "field-forming" bodies.

Figure 6 Concentric arrangement of star clusters.

(Source – Wikipedia)

The flow of matter from one galaxy to another

Astronomers are aware of the phenomenon of broadcast flowing from star to star or from one galaxy to another. It is called "frame dragging." This phenomenon is seen especially clearly in "close systems of double stars or galaxies" (Figure 7). This figure very clearly shows the peculiarity of this process, which consists in the unchanged position of the centers of clusters of stars, while the peripheral layers move with acceleration. This is explained by the fact that in the centers of clusters $\nabla\rho = 0$, while for the peripheral layers it is violated. As a result, one star or galaxy seems to "undress" another. In this case, it is not necessarily the smaller of the galaxies that "undresses": everything depends on the spontaneously arising gradient of matter density in a particular region of space, as follows from the bipolar law of gravity (5). This is reminiscent of the "undressing" of one galaxy by another, which has a greater "steepness" of the front $d\rho/dr$, and not its size. This is clearly visible from Figure 7, where the arm of a large galaxy, accelerating as it approaches the small galaxy, gradually thins, and heats up. Such threads permeate the entire visible part of the Universe, which was the reason for calling them the "web of the Universe." Its presence shows the prevalence in space of the phenomenon of matter flow from one star or galaxy to another.

"Black holes" as "star factories"

It is known that there is a fundamental difference between the observed size of "black holes" (BH) and the diameter of the "Schwarzschild sphere," found from the condition that light reaches "second cosmic speed." Meanwhile, according to the bipolar law of gravity (12), the gravitational forces in outer space are tens of orders of magnitude higher than the Newtonian forces found for one of the pairs of space objects. So, the size of this sphere should be increased. There is currently insufficient data for its calculation, but there is every reason to accept it based on observational astronomy data.[19]

Figure 7 Flow of matter from a large galaxy to a small one.

(Source – Wikipedia)

The above also changes the very assessment of the role of black holes in the evolution of the Universe. Nobel Prize winner 2018 R. Penrose explained the occurrence of black holes by gravitational collapse, i.e., the catastrophically rapid compression of massive stars under the influence of gravitational forces after their supply of thermonuclear fuel has been exhausted.[20] In contrast, the energy-dynamic theory of gravity states that the star did not have any first "reserves" of thermonuclear fuel. On the contrary, these reserves were created gradually due to the condensation of the latent mass, accompanied by the absorption of its energy (~935 MeV/amu), nucleosynthesis and the later complication of chemical elements. Further, black holes, by definition, have such powerful gravity that even light cannot leave it. According to the bipolar law of gravity (14), this state is achieved gradually as the hidden mass becomes denser. Therefore, it is more natural to assume that black holes are a product of evolution, not "collapse," and are formed from "voids" as the density increases to a state sufficient to "confine light." But even then, the stellar matter "sucked in" into the black hole does not disappear, but increases its concentration until it begins to escape from the black hole in the form of "jet" from their center, where the relative density gradient $\nabla\rho/\rho$ and gravitational force are minimal (Figure 8). When these processes intensify, black holes turn into zones of increased luminosity, saw as a bright spot in the center of the galaxy. Thus, black holes are not "gravediggers," but "factories" of stars.

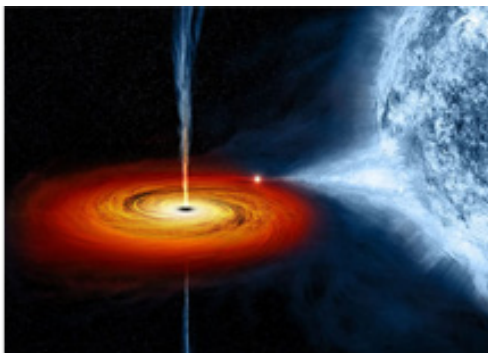

Figure 8 Black hole swan X-1.A

(Source – Wikipedia)

Discussion of results and conclusion

The methodologically and mathematically rigorous and non-postulate nature of the theoretical substantiation of the positions

put forward by energy dynamics, along with many of their confirmations, allowed the Israeli Association of Inventors (IAI) to issue two diplomas to the author of this article for the discovery of the "Phenomena of gravitational repulsion" (IAI Diploma No. 017-2018 dated 10.22.2018) and "Local cycles of the Universe" (IAI Diploma No. 017-2020 dated July 10, 2023).

The novelty of the proposed theory is manifested in the following:

I. If modern physics considers conservation laws to be a consequence of the homogeneity and isotropy of space, then energy dynamics proves the impossibility of the occurrence of any processes in homogeneous continuum media.

II. If modern astrophysics recognizes the "arrow of time" based on the principle of increasing entropy, then energy dynamics proves the inevitability of the simultaneous occurrence of evolutionary and involutionary processes in different areas of the Universe.

III. If theoretical physics considers gravitational forces to be the weakest type of interaction, then energy dynamics proves the existence of "supergravity," considering gravity the main driving force of all evolutionary processes in the Universe.

All this affects the paradigm of natural science and forces us to reconsider our ideas about the past and future of the Universe. In this regard, the following predictions of the energy-dynamic theory of the Universe are important:

I. Due to the circulation of matter and energy of the Universe, the "reserves" of its gravitational energy are in principle inexhaustible, which allows the Universe to exist indefinitely, bypassing the state of equilibrium.

II. The processes of "reification" of the unstructured matter of the Universe and the accompanying "cold" and "hot" synthesis of chemical elements are opposite to fission reactions and therefore are "energy-consuming."

III. The complication of chemical substances in the process of evolution of any part of the Universe occurs spontaneously and continuously, accelerating only in processes of a catalytic nature.

IV. Gravitational interaction does not depend on the nature of matter and therefore is universal. All other types of interaction are its weaker variety, weakened by the participation of only part of it in oscillations.

V. The formation of planets from small celestial bodies precedes the birth of stars, which are formed from them as they warm up.

VI. The actual dimensions of "black holes" are tens of orders of magnitude larger than the diameter of the Schwarzschild sphere and correspond to their observed values due to the presence of "supergravity" in them.

At the same time, considering the above observational astronomy data, a number of non-trivial conclusions can already be drawn:

I. Evolutionary and involutionary processes (removing and bringing it closer to equilibrium) simultaneously occur in the Universe;

II. "Isolation" of the potential energy of interaction of two celestial bodies from the total energy of the gravitational field of the Universe leads to an underestimation of gravitational forces in outer space by tens of orders of magnitude and to a belittlement of its role as "fuel" and "driving force" of the eternal functioning of the Universe.

III. Gravity is caused by the inhomogeneous distribution of the density of the cosmic environment and exists even in the absence of "field-forming" bodies in it.

IV. There are gravitational forces of both gravity and repulsion, which leads to the formation of extensive "voids" and the orderly arrangement of star clusters in the form of spherical shells or ring structures.

V. "Black holes" appear at a certain stage of the evolution of a galaxy when the gravitational forces in it reach the "threshold" of radiation confinement. When the forces of internal pressure exceed the forces of gravity, they turn into centers of increased luminosity, which is perceived as "the birth of a supernight."

VI. The Universe is characterized not only by the "scattering" (pushing apart) of galaxies, but also by their "merging," which leads to large-scale disturbances in outer space and the emergence of shock gravitational waves, mistakenly taken for waves of the "space-time metric.

VII. In outer space there are zones of stable equilibrium responsible for the phenomenon of liberation.

VIII. The non-Newtonian nature of the rotation curves of galaxies is explained by the uneven distribution of matter in it with a decrease in the density of their peripheral layers.

IX. Massive celestial bodies have their own "gravitational zones", in which the influence of other bodies can be neglected. For small celestial bodies, on the contrary, it is possible in a number of cases to neglect their gravitational forces, which is not characteristic of Newtonian gravitational forces.

X. The flow of matter from one star to another is determined in accordance with the bipolar law of gravity by the difference in density gradients and does not depend on their sizes.

All of the above requires a revision of the existing "standard cosmological model" based on the concept of the "big bang" and encourages a return to the ideas of the "eternal" and "infinite" Universe that come from the depths of millennia.by the bipolar law of gravity by the difference in density gradients and does not depend on their sizes.

All the above requires a revision of the existing "standard cosmological model" based on the concept of the "big bang" and encourages a return to the ideas of the "eternal" and "infinite" Universe that come from the depths of millennia.

Acknowledgments

None.

Conflicts of interest

The authors declare that there is no conflict of interest.

References

1. Ade PAR, Aghanim N, Alveset MIR, et al. Planck 2013 results. I. Overview of products and scientific results. *Astronomy and Astrophysics*. 2012;1303:5062.
2. Clowe D, Bradac M, Gonzalez AH, et al. A direct empirical proof of the existence of dark matter. *Astrophysics.* 2006.
3. Bazarov IP. *Thermodynamics*. 4th edn. M: Higher School; 1991.
4. Etkin V. Energodynamics (thermodynamic fundamentals of synergetics). New York: 2011; 480 p.

5. Etkin V. Synthesis of the fundamentals of engineering disciplines (energy-dynamic approach to knowledge integration). *Lambert Acad Publ Saarbrücken*. 2011;290.
6. Crawford F. *Berkeley course in physics.* T3: Waves M Mir; 1965. p. 529.
7. Whittaker E. *History of the theory of ether and electricity*. Moscow: Izhevsk; 2001.
8. Einstein A. Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig? *Ann d Phys*. 1905;18:639.
9. Krauss L. Everything from nothing: how did the Universe arise? M Mir; 2012. p. 280.
10. Feynman R. Character of physical laws. M Physical Encyclopedia; 1984.
11. Etkin VA. Energodynamic theory of gravitation. *Aeron Aero Open Access J*. 2019;3(1):40–44.
12. Etkin VA. To the theory of a unified field. *Sch J Eng Tech*. 2021;9(10):168–175.
13. Etkin VA. On energy consumption in the synthesis processes. *Journal Scientific Israel - Technological Advantages*. 2021;23(3,4).
14. Schrödinger E. *New paths in physics*. M Nauka; 1971. p. 428.
15. Demyanov VV. Experiments conducted to identify the fundamental differences between diffraction and interference of waves and electrons. *ArXiv*. 2010;1002:3880.
16. Jeans JH. *The new background of science*. London: 1933.
17. Etkin V. Energodynamic field theory. *Global Journal of Science Frontier Research: A Physics and Space Science*. 2021;21(2):1–29.
18. Etkin VA. Local cycles of the universe. *International Journal of Frontiers in Engineering and Technology Research*. 2023;5.
19. Etkin VA. Resolving the mysteries of the Universe from the perspective of energodynamics. *German International Journal of Modern Science*. 2020;3(1):25–31.
20. Penrose R. *Collected works*. Six Volume Set. Oxford University Press; 2010.