Research Article

From the theories of relativity to the concept of absolute

Abstract

It is shown that Galileo's principle of relativity, after its generalization by Lorentz, Poincaré and Einstein, essentially became the principle of indistinguishability of processes, preventing the study of their specifics. A theory of the power of real processes, called energy dynamics, is proposed, which does not need inertial reference systems (ISR) and proves the existence of a preferred (absolute) FR associated with the center of mass of the system with its uniform distribution. Energy dynamics is based on the principles of distinguishability of processes and the certainty of the state of the system and generalizes equilibrium and non-equilibrium thermodynamics to non-thermal machines and forms of energy, making it possible to study closed systems by introducing additional parameters of their spatial heterogeneity. Due to this, it allows to prove the fallacy of the substitution of momentum by inertial mass and statements about the dependence of mass on speed, about the equivalence of mass and energy, about the constancy of the speed of light and about the unity of space and time. Along with this, the inconsistency of the requirement for the invariance of all laws of physics in various IFRs, the need to measure any system parameters in absolute scales and the independence of space and time as parameters of the state of energy-dynamic systems are substantiated. Thus, the ground is prepared for the transition from the theory of relativity to the theory of absoluteness.

Keywords: energy forms, conservation laws, theories of relativity, absolutes, frames of reference, research methodology

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Introduction

The development of theoretical physics in the 20th century is characterized by a sharp turn from the classical (phenomenological) method of studying natural phenomena, based on experience, to the postulate method, based on the subjective ideas of the researcher or the equations of mathematical physics. The latter was expressed, in particular, in the search for their symmetries, i.e., such transformations of space and time in which the form of writing equations or a combination of certain physical quantities would remain unchanged in any inertial frame of reference (FR). The first who attached importance to the problem of simultaneity and the study of the symmetry properties of physical phenomena for the analysis of the fundamental laws of nature was the French mathematician A. Poincaré.[1] He introduced into consideration a special group of symmetries of H. Lorentz[2] associated with his transformations of space and time. At the same time, he considered it necessary to extend the principle of Galileo's relativity to electromagnetic phenomena, based on the "impossibility to show by experience the absolute motion of the Earth" proved by Michelson's experiments. A. Einstein in 1905 extended this postulate of Poincare's relativity to all natural phenomena and put it at the basis of his theory of relativity.[3] According to this principle, no experiments carried out inside an arbitrary system can distinguish between the states of its rest or uniform rectilinear motion relative to any inertial reference frame (ISR). This means, in particular, that the laws of these phenomena must be invariant (unchanged) during the transition from one IFR to another. Simply put, physical laws should be formulated in such a way that they do not include the absolute velocity of the physical system as a whole υ_o, and the states of rest or uniform rectilinear motion are indistinguishable, A. Poincare in 1895 extended this principle to electromagnetic phenomena, calling it the postulate of relativity. According to him, not only mechanical, but also electromagnetic experiments carried out within an arbitrary reference frame cannot distinguish between the states of rest and uniform rectilinear motion.

Hence it followed that the physical laws should be formulated in such a way that the rest and uniform rectilinear motion of the system were indistinguishable.[3]

Gradually, this principle of indistinguishability of rest and uniform rectilinear motion in any IFR became the main initial principle of the theoretical construction of all physics. First, A. Einstein formulated the principle of local indistinguishability of gravitational and inertial forces, calling it the principle of equivalence of inertial and gravitational masses and putting it at the basis of the general theory of relativity (GR). Thus, the indistinguishability of the dynamic effects of acceleration and gravitation was extended to non-inertial frames of reference and became almost the principle of scientific research. In electrodynamics, this was expressed in the principle of indistinguishability of electrons; in elementary particle physics - in the identity of particles of a certain class; in nuclear physics - in the indistinguishability of protons and neutrons, in field theory - in the indistinguishability of strong interactions with charges of different signs, etc. sign of "harmony of nature". Emphasis on the symmetry properties of the equations of mathematical physics required a rethinking of spatial-temporal and cause-and-effect relationships. This was accompanied by a voluntary refusal of physics from its main purpose - the explanation of certain phenomena. However, many of them have become inaccessible to human understanding. A crisis of misunderstanding arose that affected natural science as a whole.

The way out of this situation requires, in our opinion, the return of theoretical physics to the classical path of development, in which the main attention was paid to the study of the specifics of this or that phenomenon. This is especially necessary in astrophysics and cosmology, since complete ignorance of the processes occurring outside the Universe as whole forces us to consider it as a closed (isolated) system. For such systems, their total energy E is equal to their internal energy U, so that the thermodynamic law of its conservation during energy exchange becomes inapplicable for it,

and it becomes necessary to study internal processes. Such processes are possible only in the absence of equilibrium in the system, which requires the use of the conceptual system and mathematical apparatus of the thermodynamics of irreversible processes (TIP).[4,5] However, it does not consider reversible processes associated with the performance of useful (technical) work, including work "against equilibrium" in the system. This task was set by energodynamics as a further generalization of non-equilibrium

Thermodynamics to non-thermal machines and forms of energy.[6] Energodynamics, like classical thermodynamics, requires knowledge of the absolute value of such parameters as temperature, pressure, entropy, energy, etc. But on the other hand, it does not need inertial frames of reference, which allows it to serve as a "touchstone" of any theory that takes into account the relative movement. Therefore, it is of interest to compare the results of her approach with the theory of relativity (RT).

The concept of distinguishability of processes as an antipode to the principle of relativity

Energodynamics as the successor of equilibrium and non-equilibrium thermodynamics offers a different way of constructing any dynamic theory, which does not contradict the principle of relativity, but at the same time recognizes the existence of a preferred frame of reference in which various phenomena are described and explained most simply. Such, in particular, are the phenomena associated with the rotation of the object of study. As is well known, the principle of relativity is not applicable to the rotational motion prevailing in the Universe due to the emergence of centrifugal and centripetal forces. It is not applicable, strictly speaking, to any other forms of motion, since we will never be sure that the frame of reference is moving uniformly and rectilinearly. Therefore, inertial reference systems (IFS) are an abstraction useful only in a limited number of cases. This tip the scales in favor of the thermodynamic approach, which operates with the concept of internal energy U as that part of it that does not depend on the movement or position of the system relative to the external environment. This makes it necessary to use absolute values such as absolute temperature T, pressure p and entropy S. The latter also applies to energo- dynamics, which can be defined most briefly as a generalization of equilibrium and non-equilibrium thermodynamics to non-thermal machines and forms of energy. This theory generalizes the concept of internal energy U, transferring it to the total energy of isolated non-homogeneous systems. Such systems will include the entire set of interacting (mutually moving) material objects, so that for them the term "system energy" is exhaustive and does not need prefixes such as "internal", "intrinsic", etc.

According to the general principle of classical thermodynamics, which defines equilibrium as a state in which any macroprocesses cease, energy dynamics studies internally nonequilibrium (nonhomogeneous) systems and non-static processes occurring in them. This requires an appropriate generalization of some initial axioms and principles of thermodynamics. Such, in particular, is the "axiom of distinguishability of processes", according to which in the system under study one can single out (with the help of the entire arsenal of experimental tools) independent processes that cause specific, qualitatively distinguishable and irreducible changes in the state of the system".[6] This axiom, implicitly underlying any classification of processes, reflects the ability, confirmed by centuries of experience, to distinguish processes not only by the causes that cause them, and not only by its "mechanism" (the way energy is transferred), but also by their consequences. This is manifested in the search for each of the independent processes of its "coordinate", i.e.,

a physical quantity, the change of which is a necessary and sufficient sign of the course of this process. These coordinates are such parameters that do not change with the simultaneous flow of other independent processes in the same space elements. Such, in particular, are the volume V or the entropy S, which remain unchanged in the absence of volumetric deformation and heat transfer but change with necessity in these processes. Hence, in classical thermodynamics, the requirement of reversibility of processes followed, i.e., the absence of spontaneous changes in entropy and volume, not related to external heat transfer or expansion works.

The fundamental significance of the axiom of distinguishability lies in the fact that it allows us to prove a very important theorem for any interdisciplinary theory on the number of degrees of freedom of the system under study, according to which "the number of energy arguments U as a function of the state of the system (i.e., the number of degrees of freedom of the latter), is equal to the number of independent processes taking place in it." This proposition is easily proved "by contradiction". Indeed, a process is understood as a change in the properties of the system, expressed by state parameters. Therefore, during their course, at least one of them necessarily changes. Let us assume, however, that in the course of any independent process several coordinates of the state change with necessity. Then, obviously, these coordinates will not be independent, which contradicts the original premise. Suppose now that any of the coordinate's changes with the need for several processes. Then, obviously, these processes will not be independent, since they cause the same changes in the properties of the system, which also contradicts the original premise. It remains to be concluded that any (equilibrium or non-equilibrium, quasi-static or non-static) independent process corresponds to a single independent state coordinate. Such coordinates in the general case are extensive quantities, since each of them, in the absence of other degrees of freedom, determines the energy of the system, which is also an extensive quantity.

The aforementioned provision defines the necessary and sufficient conditions for an unambiguous (deterministic) assignment of the state of a particular system. Therefore, for ease of reference, it is appropriate to call it the "state certainty principle". Being in some sense the antipode of "Heisenberg's uncertainty principle", this principle allows avoiding both "underdetermination" and "redefinition" of the system, which is the main source of methodological errors of modern theories. It is far from obvious, for example, the "underdetermination" of the state of the continuum, which leads to the adoption of the hypothesis of local equilibrium in the thermodynamics of irreversible processes (TIP).[4] This hypothesis assumes the presence of equilibrium in the elements of the continuum (despite the occurrence of dissipative processes in them), the sufficiency of equilibrium parameters for their description (despite the presence of a potential gradient), and the preservation of all thermodynamic equalities (despite their inevitable violation in irreversible processes). In reality, the continuum is a system with an infinite number of degrees of freedom, which forces it to be divided into volume elements. That is why TIP does not reach the completeness and rigor that were characteristic of the classical thermodynamic method.

Even less obvious is the "underdetermination" caused by the application of the principle of indistinguishability of the state of rest and relative motion to a multicomponent closed system in which diffusion mixing of components is observed. If for such a system only the law of conservation of momentum P of the system as a whole ($d\mathbf{P}/dt = 0$) is used and the moment of the k-th components of the system P_k are not introduced, then these states will indeed be indistinguishable.

Another example of the "underdetermination" of the system is A. Einstein's hypothesis of the unity of space and time, which asserts their relationship without introducing any parameters that characterize it. As a result, the energy of the relativistic system E is written in the same form of the function $E = E[r(t), t]$ of the independent arguments of space (radius vector r) and time t as the nonrelativistic one.

As an opposite process of "redefining" the system, one can cite Cartan's - Einstein's GR of an orientable point, in which additional angular coordinates of its rotation are introduced, although for a material point that does not have dimensions, its rotation is meaningless, as well as the concept of the rotation energy of a point. In this regard, the theory of physical vacuum by G. Shipov is also indicative, which introduces 3 more coordinates of rotation of a material point in space-time.[7] Such attempts to describe the properties of the object of study with an excessive number of parameters are fraught with no less danger, especially since all the consequences of this are unpredictable.

Parameters of inhomogeneity of none equilibrium systems

In accordance with the principle of distinguishability, energy dynamics singles out at least two categories of processes in spatially inhomogeneous media, each of which has its own group of independent coordinates. The first group includes the processes of transferring a carrier of one form or another of movement in the system Θ_i (for short, an energy carrier) through the boundaries of the system with a further uniform distribution of the introduced value Θ_i between parts (regions) of the system. A special case of such processes are reversible (equilibrium) processes of heat transfer, mass transfer, volumetric deformation, etc., studied by equilibrium thermodynamics, which, due to their quasi-static nature, practically do not violate the spatial homogeneity of the system. The entropy S (which has the meaning of a thermal impulse[3]) acts as the energy carriers Θ_i for the thermal form; for the energy of elastic deformation - the deviation of the volume V of the system from the volume V_i characteristic of a given gas, at which the pressure in it is equal to zero; for electrostatic energy, charge Θ_e; for the chemical energy of k-th substances - the number of its moles N_k; for gravitational energy - the mass of the system M, for kinetic energy - the components Mv_α (α =1,2,3) of the impulse $P = Mv$, etc., etc.). All processes of this kind are reminiscent of uniform precipitation on an uneven (generally) surface.

Processes of redistribution of the energy carrier Θ_i between the parts (areas, phases, components) of a heterogeneous system as a whole are of a different kind. They are accompanied by a decrease, for example, in entropy S, mass M, charge Θ_e, impulse P, etc. in some parts of the system, and their increase in others. Such counterdirectional processes are associated with the deviation Δr_i of the radius vector r_i of the center of the extensive quantity Θ_i from its position at internal equilibrium (homogeneous distribution). These processes are directed (ordered) in nature, reminiscent of the transfer of liquid or bulk materials from one part of the vessel to another. Such processes are always non-equilibrium, even if they are carried out infinitely slowly (quasi-statically), since the system remains spatially inhomogeneous. This kind of state change causes ordered (for example, technical) work to be performed on the system, as well as vector relaxation processes, accompanied by equalization of temperatures, pressures, chemical and other potentials of the system. Instead of the coordinates Δr_i, which have the meaning of displacement vectors, the "distribution moments" $Z_i = \Theta_i \Delta r_i$ of the parameters Θ_i are very convenient, since the value Θ_i remains unchanged in the redistribution processes.

Strictly speaking, the coordinates r_i refer to the external parameters of the system, since they characterize the position of the center of the energy carrier Θ_i as a whole relative to external bodies (environment) in the same way as the center of gravity of the system r_m or its center of inertia r_k.[8]

For brevity, we will not touch here on another group of reorientation processes associated with a change in the direction of the displacement vector Δr_i and manifested, for example, in the establishment of a single orientation of the spins of elementary particles, in the spontaneous magnetization of ferromagnets, in the establishment of a certain configuration of atoms in molecules, in alignment in one (close to the equatorial) plane of celestial planetary orbits, in the rotation of galaxies, etc. It is only important to understand that as research deepens, the number of distinguishable processes can increase, which should be taken into account when developing a method for describing the state of the systems under study.

As follows from the above, each energy carrier Θ_i corresponds to its own form of energy U_i as a function of its position in space, i. e. $U_i = U_i(\Theta_i, r_i)$, so that the energy of the system as a whole, as the most general function of its state, has the form $U = \Sigma_i U_i(\Theta_i, \mathbf{r}_i)$. This allows us to express its total differential as an identity:

$$dU \equiv \Sigma_i \Psi_i d\Theta_i + \Sigma_i \mathbf{F}_i \cdot d\mathbf{r}_i, (i, = 1, 2, n), \qquad (1)$$

Where $\Psi_g \equiv (\partial U / \partial \Theta_i)$ are the averaged values of the generalized potentials of the system (absolute temperature T, pressure p, chemical, electrical, gravitational, etc. potential of the k-th substance; $F_i \equiv (\partial U / \partial \mathbf{r}_i)$ are generalized forces in their general physical understanding. This identity in application to isolated systems $(dU_{iz} = 0)$ reflects the law of conservation and transformation of energy. It is the embodiment of A. Poincaré's group theory, which serves as a means for bringing order to the equations of mathematical physics. This is manifested in the fact that in such an (integral) form of the conservation law, the time derivative of the energy of the system U determines the power of the process; by the amount of energy carrier Θ_i – its potential Ψ_i; by displacement $d\mathbf{r}_i$ – force F_i. In turn, the time derivatives of Θ_i determine the scalar flows (consumption) of the energy carrier, and the displacement derivatives $d\mathbf{r}_i$ determine the generalized rates of the processes υ_i (vector flows $J_i = \Theta_i \upsilon_i$); the derivatives of the velocity υ_i determine the accelerations, and the derivatives of the potentials Ψ_i with respect to the displacements $d\mathbf{r}_i$ determine their gradients, called thermodynamic forces, etc. This allows one to find similar quantities for any form of energy and extend identity (1) to any of the branches of physics.

If each of the 2n independent arguments Θ_i and r_i included in identity (1) would require its own frame of reference (FR), then the study of polyvariant systems (with many degrees of freedom) would become unimaginably difficult. Hence the importance of finding preferred reference systems that would reduce their number to a minimum.

The need to use absolute scales

Let us now show that for each form of partial energy U_i of a polyvariant system, there is a unique (absolute) frame of reference that guarantees the fulfillment of the energy conservation law for all possible processes in the system. To this end, let us turn to the energodynamic identity (1). According to him, the law of conservation of energy is violated if any of the parameters Θ_i or r_i change not due to energy exchange or energy transformation, but due to a change in its reference system (RS). This means that the RS of these parameters must necessarily be absolute, i.e., remain unchanged during any

processes occurring in the system. This requirement also applies to potentials. To verify this, we apply the method of finding equilibrium conditions, the idea of which belongs to D. Gibbs (1885).[6] Consider a system that is isolated as a whole, divided for simplicity into two parts (subsystems) by a partition that is permeable only to the i-th energy carrier Θ_i (for example, a heat-permeable or movable partition when the conditions of thermal and mechanical equilibrium are established, respectively). Since the energy of the system as a whole U remains unchanged in the process of establishing equilibrium, the equilibrium condition is expressed in the absence of its variation δU with any energy variations in the subsystems. In this case, the energy conversion processes described by the second sum of identity (1) stop $(F_i \cdot d\mathbf{r}_i = 0)$. Denoting the parameters in these subsystems with one and two strokes, based on (1) we have: $\delta U'$ and $\delta U''$ subsystems (due to the dynamic nature of thermal equilibrium):

$$\delta U = \delta U' + \delta U'' = \Psi_i' d\Theta_i \not{\text{¢}} + \Psi_i'' d\Theta_i'' = 0 \quad (2)$$

Considering that the system as a whole is isolated $(\Theta_i = const)$, we find that in the state of equilibrium, possible variations of Θ_i' and Θ_i'' in subsystems are subject to an obvious limitation:

$$\delta\Theta_i = \delta\Theta_i' + \delta\Theta_i'' = 0 \quad (3)$$

Considering (2) together with the equation of superimposed constraints (3), we come to the conclusion that in the equilibrium states the potentials Ψ_i' and Ψ_i'' are equal in both subsystems:

$$\Psi_i' = \Psi_i'' \quad (4)$$

Since this equilibrium condition is of a general nature and does not depend on the nature of the substance in the subsystems, the parameters Ψ_i in any subsystems must be measured in the RS, which is the same for all substances. Such scales are called universal. Further, equality (4) remains valid as long as the exchange of energy in the i-th form between subsystems is possible, that is, until the movement of this kind in any subsystems has completely degenerated (disappeared). This means that the potentials Ψ_i' and Ψ_i'' should be measured in RS, the zero of which corresponds to the complete "degeneration" of a given degree of freedom in all conceivable bodies and parts of the system. For temperature T as a heat transfer potential, these requirements, as is known, answers the Kelvin scale. This line of reasoning can be extended to any type of energy exchange. It is no coincidence that to prove the entropy S vanishes at $T = 0$, it was necessary to introduce the 3rd law of thermodynamics. This makes it quite obvious that it is necessary to measure not only temperature in the absolute scale and pressure, but also chemical, electrical, gravitational, kinetic υ and any other potential of the system under study.

In particular, for the process of exchange between subsystems of momentum, the role of the parameter Θ_i is played by the components $P_\alpha = m\upsilon_\alpha(\alpha = x, y, z)$ of the impulse $P = Mv$. In this case, the role of the "kinetic potential" Ψ_w is played by the corresponding component $\upsilon\alpha$ of the velocity vector υ.

Consequently, any velocity components must also be counted from absolute zero, corresponding to the termination of this kind of energy exchange, up to the disappearance of relative motion in all bodies of the system under study. Finding such an absolute reference system (AFR) for the kinetic potential $\Psi_w = \upsilon_\alpha$ is not difficult at all. To do this, it is only necessary to take into account that in an isolated system that has reached a state of internal equilibrium (uniform distribution of any energy carriers Θ_i), the position of their centers r_i coincides with the center of its volume occupied by the system and cannot be changed in any way. Therefore, their position in a state of equilibrium can be taken as the absolute reference point for the processes of movement of any extensive parameters of the system.

Relativistic thermodynamics as an example of the inapplicability of the principle of relativity

Unfortunately, the position proved above did not become the property of not only mechanics and electrodynamics, but also thermodynamics itself, the principles of which A. Einstein considered irrefutable. In the very first years following the appearance of his fundamental work (1905), some physicists hastened to give the physical laws a form invariant with respect to any inertial reference frames. In the field of thermodynamics, this attempt was made for the first time by M. Planck himself (1907) .[7] He considered a heat engine in the form of a cylinder with a gas under a piston, operating according to the Carnot cycle with a fast-moving heat source. After adiabatic compression of the gas and its acceleration, the working body of the machine receives heat from a moving heat source at a temperature $\dot{O}_1{}'$. Then the cylinder with gas slows down adiabatically to a state of rest, and the temperature of the gas becomes equal to $\dot{O}_1$. After that, the gas in the cylinder expands adiabatically to the temperature of the heat receiver T_2, gives it a certain amount of heat Q_2 at the temperature T_2 and again adiabatically contracts to the temperature T_1. Following this, the gas cylinder accelerates again, and the cycle repeats.

Based on the expressions known from mechanics for the transformation of energy and the work of acceleration dW_W, he came to the conclusion that heat Q and absolute temperature T should be converted in accordance with the expressions $Q' = Q/\gamma$; $T' = T/\gamma$, where Q', T'– heat and temperature in the frame of reference moving relative to the observer with the speed $\upsilon = |\upsilon|$; $\gamma = \left(1 - \upsilon^2/c^2\right)^{-\frac{1}{2}}$ is the Lorentz factor, c is the speed of light in vacuum. At the same time, he obtained an expression for the thermal efficiency of the relativistic Carnot cycle in the form

$$\eta_t^K \equiv W'/Q' = 1 - T_2\gamma/T_1 \quad (5)$$

The ratios found by M. Planck were approved by A. Einstein. So, it was until in 1963 H. Ott discovered the absurdity of this result from the point of view of thermodynamics itself [8]. Indeed, if we accelerate the heat source itself with a temperature T_1 to a speed v, use its heat Q' in a relativistic Carnot machine (with a rapidly moving heat reservoir) and then slow down again to a speed $\upsilon = 0$, then the result of these operations should be accuracy coincide with the operation of the classical Carnot machine. However, this does not happen. H. Ott's article was not seen during his lifetime. However, H. Arzels (1966) soon came to the same conclusion independently of H. Ott.[9] Unlike Ott, he considered the formulas for the transformation of energy and momentum, which follow from the relativistic mechanics of elastic bodies, to be incorrect. This time the work was noticed, and an avalanche of publications followed, leading to lively discussions at international symposiums in Brussels (1968) and Pittsburgh (1969). These discussions revealed such chaos in the field of defining the basic concepts of thermodynamics, and such inconsistency in the relativistic transformations of thermodynamic quantities, that H. Arzels was forced to declare a "modern crisis in thermodynamics." They even agree that the application of one or another formula of relativistic transformations of thermodynamic quantities depends on the position of the thermometer in space.[10] It was a rare case for physics when the absurdity of the results was discovered only half a century later and was not resolved in a satisfactory way. After all, Planck's transformations did not leave invariant the expression for the efficiency of the Carnot cycle η_t^K (5), which was one of the mathematical formulations of the second law of thermodynamics (the principle of an excluded perpetual motion machine of the 2nd kind), and the requirement of invariance of physical laws should have been

applied to it. Meanwhile, according to Planck, the temperature of a moving source is always lower than that measured in a stationary frame of reference, and in accordance with his transformations, the efficiency of the relativistic Carnot cycle (5) is always less than that of the classical one. Moreover, for certain γ, this efficiency may even turn out to be negative. It was only within the framework of energy dynamics that it was possible to show that the relativistic Carnot machine is a combined thermal-mechanical engine that converts thermal and mechanical energy in one cycle. The efficiency of such a combined machine takes an intermediate value between the efficiency of each of them separately, approaching one of them as the ratio between both forms of energy changes. This efficiency is invariant under Lorentz transformations.[11]

However, even without a detailed analysis of the relativistic Carnot machine, it should have been obvious that the internal energy of the system *U*, by virtue of its definition as a part of the energy that does not depend on the motion of the system, is not subject to relativistic transformations (invariant). This can also be stated in relation to heat and work as two independent ways of changing this energy, since each of them separately is expressed by its change. Nevertheless, the need to convert internal energy is often argued precisely by the performance of the work of volumetric deformation when the volume of the body changes due to the Lorentz contraction of its dimensions in the direction of motion. The failure of such an "argument" is obvious, since the reduction in dimensions in the direction of movement can always be compensated by a change in dimensions in the transverse direction. In addition, the indicated reduction in size also takes place in a vacuum, where no work of expansion is performed at all. Thus, there is an internal contradiction of relativistic thermodynamics, confirming its belonging to the theory of absolutism.

Negative consequences of relativism

The concept of indistinguishability of processes, hidden behind the principle of relativity, aims the researcher at finding conditions that make processes indistinguishable, instead of revealing their specificity and suggesting ways to take it into account when studying real processes. Its postulation made the understanding of physical processes unnecessary and largely illusory, and ultimately gave rise to indistinguishability between truth and error.

This can be explained by the example of the same principle of Galileo. Even in those days, sailors found a way to distinguish between the rest and movement of a ship relative to invisible shores using a line with knots. To establish whether our planet rotates, being in the closed space of the temple, it turned out to be enough Foucault's pendulum. It is possible to distinguish the light of a moving source from a stationary one by comparing their spectrum. It is possible to distinguish the uniform motion of a vessel with gas at a near-light speed from its state of rest by the weakening of the diffusion of gases in it, together with the Brownian motion, which stops with the onset of the limiting velocity. It is possible to establish whether a stone fell on the Earth, or the Earth fell on a stone by the nature of the destruction. In a word, the indistinguishability of states of rest and motion is not so obvious that it can be taken as a postulate or axiom. In addition, from the very fact of their indistinguishability, it did not yet follow that physical laws should not be formulated in the simplest and most understandable way, but in such a way that their form remains invariant in any IFR. This requirement is invalid, if only because the predominant form of motion in the multiverse is rotation, for which there is a preferred frame of reference associated with the instantaneous center of inertia. Moreover, the requirement to find the IRF is theoretically unfeasible, since we will never have a

way to make sure that any RF is moving uniformly and in a straight line. Since there is no possibility of experimental confirmation or refutation of the existence of IRF in each specific case, the theory based on it does not meet the criterion of falsifiability.

From these positions, the requirement for the invariance of the physical laws of Poincaré-Lorentz-Einstein in IRF looks rather strange, to say the least. In this regard, the energodynamic approach is a noteworthy alternative to RT, which marks the return of physics to the classical path of development.[12] In any case, energy dynamics, which does not require IRF, can serve as a "touchstone" for any relativistic theory. Considerably more realistic is the introduction of "hidden mass" (dark matter) into observational astronomy, which is not directly observable, but manifests itself in a number of phenomena. In this case, the question of the primary form of matter, from which all forms of matter in the Universe were formed, becomes the subject of terminology. More relevant is the question of the corpuscular or continuum nature of the "hidden mass". The experimental discovery of four hundred subatomic and subnuclear particles means, in essence, the collapse of "atomism" as the doctrine of "indivisibles" and makes the concept of "infinite divisibility" and the continual nature of dark matter promising. It became more obvious that the practical absence of the "ethereal wind" in the experiments of Michelson-Morley and similar interferometers is explained precisely by the wave nature of matter, for which there is no addition of the speed of the light source and the luminiferous medium. All this, coupled with the latest discoveries in the field of astronomy, forces us to critically rethink the arguments underlying the theory of relativity. Below we will briefly dwell on those of them that are the most controversial and lead to a contradiction with classical physics and experiment.

Distortion of the concept of mass by giving it the role of a measure of the inertia of the system

Introducing the concept of mass, I. Newton defined it as "a measure of the amount of matter proportional to its density and volume,[13] i. e. as a state function. This interpretation is also reflected in his definition of the force *F* based on the law of gravity. At the same time, Newton also gave another definition of the "applied" force *F* as a function of the acceleration process, defining it as a quantity proportional to the increment of momentum $P = Mv$ per unit time. Since the concept of a vector did not exist in Newton's time, this gave reason to interpret the mass M as a measure of the body's resistance to the acceleration process. In the future, such an understanding of force and mass was fixed in the distinction between the concepts of "inertial" and "gravitational" mass. The situation did not change even after the advent of vector algebra, when it became clear that Newton's law of force $F = dP/dt$ refers to the active (accelerating) force, and not to the force of inertia, for which this law has the form $F_{in} = -dP/dt$. At the same time, it became obvious that the measure of the inertial properties is not the mass *M*, but the impulse of the system *P*. This meant that the interpretation of the mass *M* in Newton's 2nd law as a measure of inertia is completely unreasonable, since it served as a source of the gravitational field and the cause, not an obstacle to movement. This corresponded to the above-mentioned energy-dynamic principles of distinguishability of processes and certainty of the state, from which it followed that mass as a coordinate of the mass transfer process cannot play the role of the coordinate of any other process, including the process of deceleration under the action of inertial forces *F* and. Unfortunately, when developing the theory of relativity, A. Einstein used precisely the distorted understanding of mass. As a result, the concepts of "rest mass", "longitudinal", "transverse" and "relativistic" mass were added to the "masses" mentioned above.

Meanwhile, such an abundance of "masses" is a direct violation of the certainty principle and evidence of a "redefinition" of the system, since its state is already uniquely determined by the parameters Θ_i as quantitative measures of the carrier of the corresponding form of energy. This can be confirmed by the principle of Le Chatelier - Brown in physical chemistry, according to which the reaction of a system to an external influence is proportional to the amount of substance in it, regardless of the units in which it is expressed.

Postulation of the dependence of mass on speed

The interpretation of mass as a measure of inertia led to the problem of the relationship between mass M and impulse $\boldsymbol{P}$, which in classical physics were considered as independent variables. The latter becomes especially obvious from the standpoint of energy dynamics, in which the mass and impulse $\boldsymbol{P}$ are the coordinates of two independent processes: mass transfer (introduction of mass (dM/dt ≠ 0) into the system under conditions of constant composition) and system acceleration *(dP/dt ≠0)*. The theoretical substantiation of the dependence of mass on speed was reduced by A. Einstein to the statement: "A constant force, although small, over a long period of time can impart a speed to a body that exceeds the speed of light *c*. To prevent this from happening, the mass must grow! Meanwhile, the increase in mass with speed contradicts the law of conservation of mass. Indeed, consider an arbitrary isolated and spatially inhomogeneous system, the parts of which are in relative motion. If the masses of these parts M_i increased with increasing their speed, then the mass of the system as a whole $M = \Sigma_i M_i$ could not remain unchanged in violation of the law of its conservation. This forces us to take a closer look at the results of experiments on accelerators. As it turns out upon closer examination, neither in Kaufman's experiments [24], nor in any other experiments with particle accelerators, the efficiency of these processes ηi was taken into account, which can be represented as the ratio of the inertial force $\boldsymbol{F}$ and ≡ - dP/dt to the "applied" for this, the force F_i coming from the electromagnetic or some other accelerating field $(\eta_i = |F_{ii}|/|F_i|)$. Taking this into account, the equation of the process takes the form corresponding to the Onsager laws in the thermodynamics of irreversible processes (TIP)[5]:

$$F_i = \eta_i^{-1} d\boldsymbol{P}/dt \qquad (6)$$

As in the equations of thermal conductivity, electrical conductivity, diffusion, etc., this expression takes into account the inevitable losses in the process of acceleration (creating a momentum flux $J_i = d\boldsymbol{P}/dt$) by introducing a drag coefficient R_i, equal in this case to η_i^{-1}. At the same time, it becomes obvious that no matter what force F_i we apply to the accelerated body, $R_i \rightarrow \infty$ as we approach the limiting speed (in this case, the speed of light c), since further acceleration is impossible. This means that equation (6) is non-linear, which makes the introduction of the drag coefficient R_i mandatory. A satisfactory expression of this coefficient R_i gives the Lorentz multiplier $\gamma = \left(1 - \upsilon^2/c^2\right)^{-1/2}$.

Consequently, the efficiency of any accelerator facility vanishes twice: at the "idling" of the facility, when the charge or any other body has not yet been introduced into the accelerating field, and in the "short circuit" mode, when the acceleration stops, and all spent to create a field, power is dissipated in the form of heat. These considerations fully apply to Kaufman's experiments on electron acceleration.[14] Thus, in them there is a change not in the mass, but in the efficiency of the process of converting the field energy into the kinetic energy of the charge. Thus, we come after academician L. Okun[15] to the conclusion that there is a single mass M, which is a measure of the amount of matter, and the concepts of "rest mass", "relativistic", "inert", "electromagnetic", "gravitational", etc. masses must be discarded as superfluous.

Postulate the equivalence of mass and energy

As far as we know, postulated by A. Einstein the principle of equivalence of the total energy of the system E to its relativistic mass M_r

$$E = M_r C^2 \qquad (7)$$

Was never criticized by thermodynamics, which he considered "the only theory of general content, the consequences of which will never be refuted by anyone".[16] Meanwhile, this analysis of this expression from the standpoint of thermodynamics leads to the conclusion that this principle is completely untenable. Let's start with the traditional expansion of this expression in terms of the rest mass of the M_o system under conditions of constancy of the speed of light in vacuum:

$$E = M_r c^2 = M_o c^2 + M_o \upsilon^2/2 + \dots \qquad (8)$$

It follows from (8) that the energy E of the fixed system $(\upsilon = 0)$ is equal to $M_o c^2$, and under the conditions M_o =const (the system is closed) it cannot be changed in any way, even if it is not isolated.[17] This position is in flagrant contradiction with the law of conservation of energy in the form (1), according to which, under these conditions, it can still be changed by varying $2(n-1)$ variables that do not depend on M_o. Thus, here we are again faced with the concept of "indistinguishability" and with the "underdetermination" of the system, since the energy E is assumed to depend only on the mass.

To find the true relationship between energy and mass, let us turn to the theory of waves,[18] according to which the propagation velocity of perturbations in any medium (in this case, the speed of light c) is determined by the partial derivative of the energy density of the elastic deformation of the medium $\rho_u = dU/dV$ by the density ρ of this medium:

$$c^2 = \partial \rho u/\partial \rho \cdot \qquad (9)$$

For the cosmic vacuum as a "hidden" (unobservable) medium, the density ρ of which is the only variable of its state, the partial derivative $(\partial \rho_u/\partial \rho)$ turns into the total $d\rho_u/d\rho$, so that its integration, taking into account the obvious relations $E = \int \rho_u dV$ and $M_o = \int \rho dV$ leads to the expression

$$U = M_o c^2 \qquad (10)$$

This kind of relationship (with a proportionality factor of ½) was obtained by N.A. Umov back in 1874, based on considerations of energy balance in the process of ether condensation.[19] A similar expression $U = (3/4) Mc^2$ was obtained by W. Thomson in 1881, taking into account the so-called "electromagnetic mass".[20] The expression $E = Mc^2$ was obtained by O. Heaviside (1890), proceeding from the concept of the radiant energy flow in the ether as the product of a light pulse $P = Mc$ and its speed c.[21] A. Poincaré (1900) and F. Hazenorl (1904) came to the same conclusion. Thus, A. Einstein in 1905 only generalized this expression to any form of energy, while setting the condition $c = const$. In the Planck system of units, where $c = 1$, this expression looked like the equality $E = M_r$ which made it possible to call it the "principle of equivalence" of mass and energy.[22] However, even in this case one could speak only of their proportionality, but not of equivalence. Only in the Planck system of units, where $c = 1$, did this expression look like the equality $E = Mp$, which gave at least some reason to talk about the "equivalence" of mass and energy.

Postulate the constancy of the speed of light

One of the fundamental postulates of SRT and GR by A. Einstein was the assumption of the constancy of the speed of light c in vacuum. This assumption, in turn, was based on the recognition of the presence

of empty space in the Universe and the corpuscular concept of light, which made it possible to exclude the influence of the environment on the speed of its propagation.

Meanwhile, on the basis of observations and the fact of the stability of the solar system, Laplace (1805) showed that the speed of propagation of gravitational interaction cannot be lower than $5 \cdot 10^7$ speeds of light.[23] Much later (in 1948), the Russian astrophysicist N. Kozyrev, using photographs of the star Orion, obtained with the telescope's metal shutters closed, discovered radiation that arrives much earlier than light in its optical range[24]

In the 1990s, this result was confirmed by a group of researchers from the Russian Academy of Sciences[25]

In the 1950s, the founder of astrospectroscopy, A.A. Belopolsky discovered that the spectrum of light shifts near bright stars, which indicated a change in the speed of electromagnetic waves depending on the properties of the environment.[26] The interstellar dispersion of the EM wave velocity discovered by him was subsequently confirmed more than once. At the same time, it turned out that EM waves with a frequency below 100 kHz have a speed significantly lower than $3 \cdot 10^8$ m/s. In the 60s, the inconstancy of the speed of light was discovered during the radar of Venus. With a radar error of ± 1.5 km and a maximum experimental error of 260 km due to the Earth's rotation, the scatter of the measurement data for the speed of light in different parts of its orbit was 2000 km.[27] The possibility of exceeding the speed of light was confirmed by the so-called "tunnel effect".[28]

During the last decades of the 20th century, X-ray telescopes discovered many objects (quasars and galaxies) that eject jets of matter at a speed several times greater than the speed of light. Other phenomena were discovered, in which "superluminal" speeds could even be measured.[29] No less evidence and slowing down of light. In 1982, the Australian scientist B. Setterfield drew attention to the monotonous decrease in the measured speeds of light over the past 300 years.[30] Another strange phenomenon was discovered using the MAGIC telescope by an international team of researchers of the Markarian 501 galaxy. Astronomers "sorted" the gamma photons coming from there with each flash into low- and high-energy ones and found out that with simultaneous emission, the latter arrive with a delay of about 4 minutes.[31] In 1999, Natura published a scientific article detailing an experiment in which the speed of light was reduced to 17 meters per second.[32] Thus, the constancy and limiting speed of light postulated by A. Einstein contradicts the experimental facts.

Artificial unification of space and time into a single continuum

In classical physics, space and time were considered as independent variables. This was confirmed by the presence of many local processes occurring in the same elements of space $(r = const)$, and, on the contrary, the possibility of simultaneous occurrence of the same processes $r = r(t)$ at different points in space. Both of them were satisfactorily described in the Lagrangian and Euler coordinate systems by representing some quantity like the potential ψ_i as a function of independent variables $\boldsymbol{r}$ and t of the form $\psi_i[r(t), t]$ In contrast to this, the space-time continuum, which combines in its dimension the product of units of length and duration, has no physical meaning and no analogues in any natural science discipline.

The geometrization of physics, for which geometry has always been one of its "branches", cannot be considered progressive, as well as its replacement of the concept of gravitational force as the cause of the motion of celestial bodies. All this testifies to the methodological inconsistency of SRT and GRT. Unlike them, the classical approach

to the problems of gravity and the physics of near-light speeds makes it possible not only to overcome the difficulties that arise, but also to synthesize the theoretical foundations of a number of fundamental disciplines.[33]

Conclusion

The concept of indistinguishability of processes, hidden behind the principle of relativity, deprives it of heuristic value. This principle aims at finding conditions that make processes indistinguishable, instead of revealing their specificity and suggesting ways to study complex processes. Its postulation made the understanding of physical processes unnecessary and largely illusory, and ultimately gave rise to indistinguishability between truth and error. This can be explained by the example of the same principle of Galileo. Even in those days, sailors found a way to distinguish between the rest and movement of a ship relative to invisible shores and bottom, casting an anchor behind the stern. To establish whether our planet rotates, being in the closed space of the temple, it turned out to be enough Foucault's pendulum. It is possible to distinguish the light of a moving source from a stationary one by comparing their spectrum. It is possible to distinguish the uniform motion of a vessel with gas at a near-light speed from its state of rest by the weakening of the diffusion of gases in it, together with the Brownian motion, which stops with the onset of the limiting velocity. It is possible to establish whether a stone fell on the Earth, or the Earth fell on a stone by the nature of the destruction.

In a word, the indistinguishability of states of rest and motion is not so obvious that it can be taken as a postulate or axiom. In addition, from the very fact of their indistinguishability, it did not yet follow that physical laws should not be formulated in the most simple and understandable way, but in such a way that their form remains invariant in any IFR. This requirement is invalid, if only because the predominant form of motion in the multiverse is rotation, for which there is a preferred frame of reference associated with the instantaneous center of inertia. Moreover, the requirement to find the ISO is theoretically unfeasible, since we will never have a way to make sure that any SO is moving uniformly and in a straight line. Since there is no possibility of experimental confirmation or refutation of the existence of IFR in each specific case, the theory based on it does not meet Popper's scientific criterion.[32]

From these positions, the requirement for the invariance of the physical laws of Poincaré-Lorentz-Einstein in IFR looks rather strange, to say the least. In this regard, the energodynamic approach is a noteworthy alternative to RT, which marks the return of physics to the classical path of development. It opens up a real possibility of synthesizing the conceptual system and mathematical apparatus of fundamental disciplines. [32] In any case, energodynamics, which does not need IFR, can serve as a "touchstone" for any relativistic theory.

i. Astrophysics and cosmology need a theory that allows us to study closed systems such as the Universe as a whole, which we are forced to consider as isolated due to the complete uncertainty of what is beyond it. Such a theory is energodynamics, which does not exclude from consideration any (reversible or irreversible) component of real processes and takes into account their nonequilibrium due to the introduction of additional parameters of the spatial inhomogeneity of such systems.

ii. This theory adheres to the classical definitions of space and time as independent variables, and therefore does not need the concept of inertial reference systems (IRF), as a result of which there is a preferable (absolute) FR for it, associated with the center of mass or inertia of the system with their uniform distribution over the

volume of the system. Therefore, energy dynamics can serve as a "touchstone" for SRT and GR.

iii. The basic principles of energy dynamics - the distinguishability of processes and the certainty of the state - are antipodes of the principle of relativity, which, after its generalization, turned into the principle of their indistinguishability and the principle of uncertainty, making it difficult to study the specifics of real processes. Due to this, it makes it possible to radically simplify the study of real processes and obtain a number of non-trivial consequences that go beyond the scope of SRT and GR.

iv. Among these results is the proof of the erroneous substitution of momentum as a measure of inertial properties by the rest mass, statements about the independence of mass from speed, about the equivalence of mass and energy, about the constancy of the speed of light and the independence of space and time as state parameters.

v. Along with this, the inconsistency of the requirement for the invariance of all laws of physics in various IFRs, the need to measure any system parameters in absolute scales, the existence of a preferred (absolute) frame of reference and the independence of space and time as parameters of the state of energodynamic systems are substantiated. Thus, the ground is prepared for the transition from the theory of relativity to the theory of absoluteness.

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Conflict of interest

The Authors declares that there is no Conflict of interest.

References

1. Poincaré A. Selected Works. Nauka; 1974;429–433.

2. Lorentz GA, Poincaré A, Einstein A, et al. The principle of relativity. 1935.

3. Einstein A. Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig? *Ann d Phys*. 1905;323(13):639-641.

4. De Groot SR, Mazur R. Non-Equilibrium Thermodynamics. Amsterdam; 1962.

5. Gyarmati I. Non-equilibrium thermodynamics. *Field theory and variational principles*. 1974. 304 p.

6. Etkin V. Energodynamics (Thermodynamic Fundamentals of Synergetics**)**. New York; 2011. 480 p.

7. Shipov GI. Theory of physical vacuum. Nauka; 1997.

8. Etkin VA. Parameters of spatial heterogeneity of non-equilibrium systems. *J Sci Israel Tech Ad*. 2017;19(1):107–110.

9. Gibbs JW. Trans Connecticut Academy. 1875;3:108–248.

10. Planck M. Sitzungsber. Akad. Wiss. Berlin. 1907. 542 p.

11. Ott H. Zeitshr Phys. 1963;70:75.

12. Arzelies H. La crise actuelle de la thermodynamique theorie. *Nuovo Cimento*. 1966;41:61.

13. Newton I. Principia. University of California Press. Berkley; 1934.

14. Kaufmann W. Die elektromagnetische Masse des Elektrons. *Physikalische Zeitschrift*. 1902;4(1b):54–56.

15. Okun LB. The concept of mass. *UFN*. 1989;158(3):511–530.

16. Bazarov IP. Thermodynamics. 4th Ed. Higher school; 1991.

17. Einstein A. Creative autobiography. Physics and reality. 1985:131–166.

18. Crawford F. Waves. Berkeley Physics course. McGraw Hill;1968.

19. Umov NA. Bewegungsgleichungen der Energie in continuirlichen Körpern. 1874.

20. Tomson W. Mathematical and physical papers. Cambridge; 1882.

21. Heaviside O. Electrical Papers. London: Macmillan and Co. 1892;(2):492.

22. Einstein A. Ann d Phys. Bd 18 Bd 20, S. 371; 1907. Bd 23. S. 371. 1911, Bd 35. S. 898:S. 1905.

23. Lapl*ace* PS. Mecanique celeste. Paris; 1805.

24. Kozyrev NA. Selected works. LGU. 1991. p. 385–400.

25. Lavrentiev MM, Eganova IA. On the Remote Effect of Stars on a Resistor. *DAN USSR*. 1990;314(2):352.

26. Belopolsky AA. Astronomical works. 1954.

27. Wallace B. The problem of space and time in modern science. 1991.

28. Hartman TE. Tunneling of a Wave Packet. *J Appl Phys*. 1962;33(12):3427–3433.

29. Cowan J. Elements of surprise. *Nature*. 2003;423:29.

30. Setterfield B. The Velocity of Light and the Age of the Universe. 1981.

31. Fraser Cain. High Energy Gamma Rays Go Slower Than the Speed of Light? 2007.

32. Hau LV, Liu C, Dutton Z, *et al.* Observation of coherent optical information storage in an atomic medium using halted light pulses. *Gale Academic OneFile*. 2001;409(6819):490.

33. Etkin VA. Synthesis of the foundations of engineering disciplines (Energodiamic approach to the integration of knowledge). Saarbrücken Palmar. 2011.