Is Modern Physics Moving Towards Metaphysics?

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Abstract

The increasing incorporation of speculative constructs such as dark matter, the Higgs field, and cosmic inflation within modern physics indicates a shift towards metaphysical frameworks, potentially compromising the empirical rigor traditionally upheld in physical sciences. This article critically evaluates the foundational paradigms in quantum mechanics and cosmology, asserting that constructs like the Big Bang theory and baryogenesis introduce elements that lack experimental validation and challenge established physical principles. By examining the epistemic and methodological implications of these paradigms, the author argues that theoretical physics must resist the encroachment of metaphysical assumptions and prioritize models grounded in measurable, observable phenomena. The article proposes a recalibration of the discipline, advocating for a return to empirically verifiable principles and logically cohesive theories that align with classical physics. Through this approach, the author suggests, physics can maintain its empirical integrity, ensuring that theoretical advancements remain anchored in experimentally testable reality and do not drift into speculative abstraction.

The term "metaphysics" used here is understood as considerations of what is unknowable, mysterious, beyond the senses and experience. Unfortunately, physics is currently moving increasingly in this direction. Physics, as an exact science, should be based on mathematical models combined with mathematical formulas that precisely describe the behavior of these models. The theoretical predictions of these models (theories) should align with experimental and observational results. If the results of a single, very carefully conducted and repeatedly confirmed experiment do not match the predictions of a physical theory, then that theory must be considered incorrect, even if a multitude of other experiments support it.

A second important point is the statement that the Universe, with its classical physical laws, is a product of quantum mechanics; therefore, the same laws must apply in quantum physics, except that in quantum physics, the laws of classical physics are fulfilled in a statistical manner. This implies that the laws of quantum physics cannot fundamentally diverge from the laws of classical physics.

The quantum nature of the Universe arises from the fact that physics does not tolerate infinity. Infinity is an abstract mathematical concept that cannot be expressed in terms of numbers, while physics describes reality exclusively through numbers. Infinity has two aspects: infinitely large and infinitely close to zero. Due to this latter type of infinity, quantum physics does not deal with continuous physical parameters, which means that space and time must also have a quantum nature. This follows, among other things, from the Planck length and Planck time as the smallest quantities that still have physical meaning.

Modern physics has found itself in the "grip" of paradigms from which it is reluctant to break free, even though many new observations and experiments indicate that some of these paradigms have become outdated. One such paradigm is the claim that the Universe originated from a single point (a singularity) that contained a vast amount of energy with infinitely high density. This refers to the Big Bang theory. In connection with this theory, a question arose for which there exists a very simple, logical answer based on known and verified laws of physics. However, this answer does not align with the Big Bang theory, so it is not considered at all; instead, the theory is surrounded by metaphysical entities such as singularity, cosmological inflation, baryogenesis, etc. The existence of such entities is not supported by any experiments, nor is there any mathematical framework consistent with the principles of physics to describe them, so they should be regarded as metaphysical entities.

The question associated with the Big Bang theory, for which there is one simple answer, is: Why is there no balance between matter and antimatter in the Universe? Because there was no such balance in the initial conditions. This answer follows from the current, experimentally confirmed laws of physics. According to these laws, any elementary particle can be created or annihilated only in a pair with its antiparticle. The proposed so-called baryogenesis requires a violation of the baryon number conservation principle. No experiment has ever shown a violation of this principle, and there are no hypotheses regarding the theoretical course of such a process. Thus, baryogenesis clearly contradicts the laws of physics and should be considered metaphysical. In this situation, we must accept the simplest and most logical answer: that the initial conditions of the Universe contained a positive baryon number. This explanation is based on simplicity and logic and does not require breaking any known physical laws. Additionally, the Universe is electrically neutral, so we can assume the hypothesis that the initial conditions of the Universe contained only neutrons. A free neutron is an unstable particle and decays into a proton and an electron. It should be noted that the current Big Bang theory does not address the question of the origin of the balance between positive and negative electric charges. (Note: During accelerator experiments, the creation of electron-positron pairs is very common, whereas the creation of proton-antiproton pairs occurs sporadically). Quantum physics offers no arguments to justify, in the context of the Big Bang theory, the balance between positive and negative charges in the Universe.

In quantum physics, there is also a paradigm that is in clear contradiction with the laws of classical physics. Specifically, it is believed that in atoms, electrons remain in orbitals despite the Coulomb force, yet this state cannot result from the action of centrifugal force, as electrons orbiting the nucleus would lose energy through electromagnetic radiation and fall into the nucleus. Artificial (metaphysical) principles were introduced, which have no justification in classical physics. It is somewhat like "Don't think, just calculate." However, all the facts indicate that at distances corresponding to orbital radii, the Coulomb force is zero. After all, the distance function in Coulomb's law, defined as $1/\mathrm{r}^{\mathbf{2}}$, could repeatedly pass through zero at distances on the order of the atomic radius, creating local potential minima. Thus, Coulomb's law should be expressed as follows:

$$\boldsymbol{F} = \boldsymbol{k_E}\, \boldsymbol{q_1 q_2 f_E(r)} \tag{1}$$

In this case, of course, the function $\boldsymbol{f_E(r)}$ must be dimensionless, and the coefficient $\boldsymbol{k_E}$ has the dimension $\left[\frac{\boldsymbol{N}}{\boldsymbol{C^2}}\right]$. Sufficient evidence that the $1/r^2$ function does not apply at subatomic distances is the electron binding energy in the hydrogen atom, which is 13.6 [eV]. Considering the atomic radius, if the Coulomb function were valid, the electron binding energy in the hydrogen atom would be more than twice the measured value.

Below is an illustrative diagram showing the possible behavior of the function $\boldsymbol{f_E(r)}$ at distances on the order of the atomic radius, as well as a graph of the electric potential energy of a two-charge system, e.g., proton-electron, where the marked local minima of potential energy correspond to individual orbitals.

Note that such a configuration of the function $\boldsymbol{f_E(r)}$ allows for the formation of stable Cooper pairs at sufficiently low temperatures, where, for example, two electrons from the conduction band of a metal reside in a local minimum (well) of the potential. Only an increase in temperature above a critical value can break this pair (eject it from the well). If the function $\boldsymbol{f_E(r) = 1/r^2}$ applied at subatomic distances, then Cooper pairs would be yet another quantum phenomenon that contradicts the laws of physics.

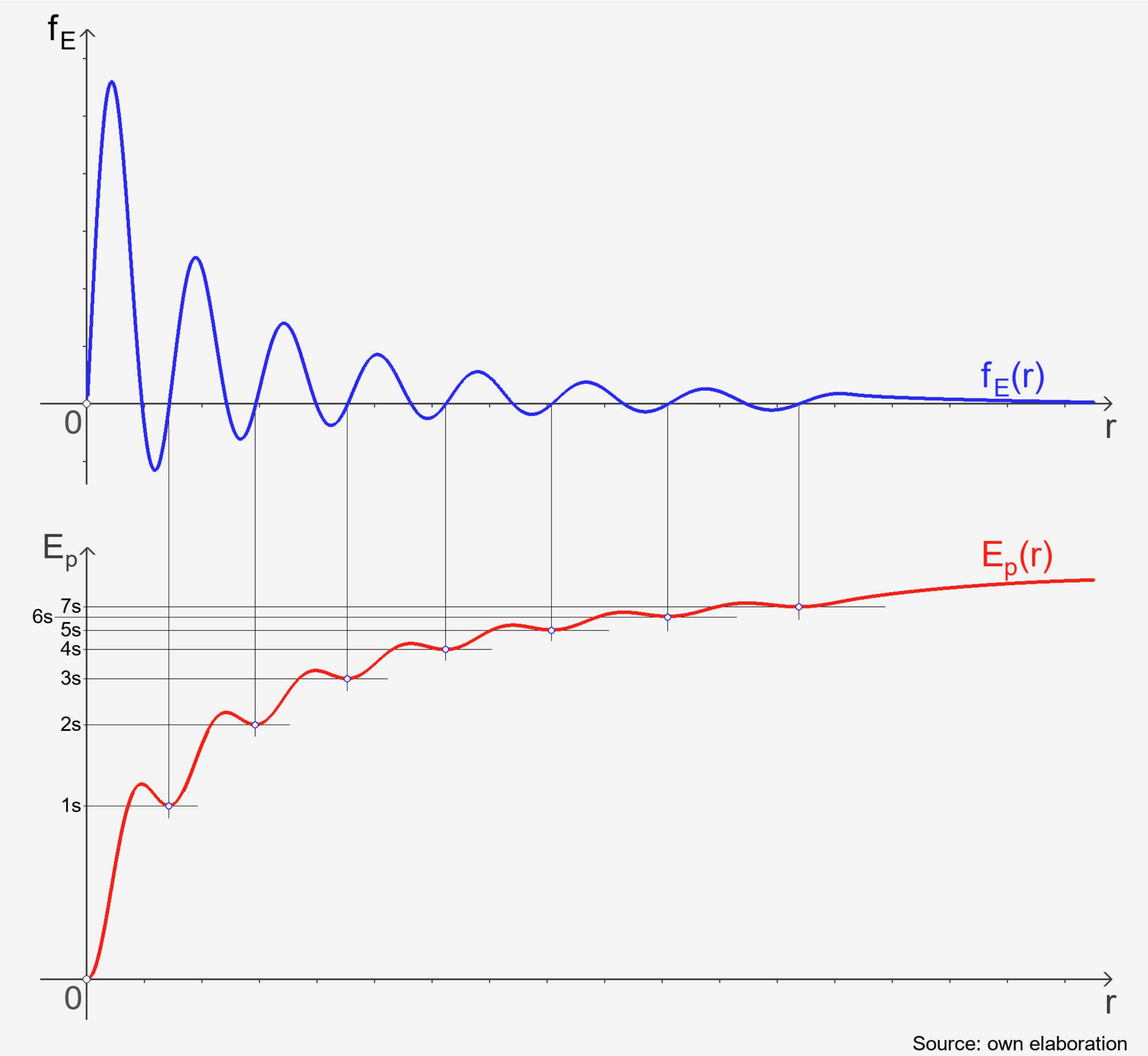


Figure 1

A significant inconsistency in modern physics is evident in the concept of the elementary electric charge. The term "elementary" implies that we are dealing with the smallest, indivisible portion of electric charge. According to quantum chromodynamics, the elementary electric charge is equal to 1/3[e]. On the other hand, it is claimed that the electron has an elementary charge of -1[e]. Physics is a precise science, leaving no room for such ambiguities. If we are to take quantum chromodynamics seriously, the electron must consist of three elementary electric charges. These charges in the electron touch each other, as the electron is a point-like object.

Let us denote by $\boldsymbol{\Gamma_E}$ the value of the integral:

$$\boldsymbol{\Gamma_E = \int_0^\infty f_E(r)\, dr} \tag{2}$$

Given what we have discussed regarding Coulomb's law at subatomic scales (see Fig. 1), integral (2) has a finite value. To bring the three elementary electric charges in the electron into contact, work equal to the electron's rest mass must be performed.

$$\boldsymbol{m_{re}} = \boldsymbol{k_E \Gamma_E} \left\{ \left(-\frac{\mathbf{1}}{\mathbf{3}}\,[\boldsymbol{e}]\right)\left(-\frac{\mathbf{1}}{\mathbf{3}}\,[\boldsymbol{e}]\right) + \left(-\frac{\mathbf{1}}{\mathbf{3}}\,[\boldsymbol{e}]\right)\left(-\frac{\mathbf{2}}{\mathbf{3}}\,[\boldsymbol{e}]\right) \right\}$$

$$\boldsymbol{m_{re}} = \boldsymbol{k_E \Gamma_E} \left(\frac{\mathbf{1}}{\mathbf{3}}\,[\boldsymbol{e}^{\mathbf{2}}]\right) \tag{3}$$

Given that

$\boldsymbol{m_{re}} = \mathbf{8.1871 \times 10^{-14}}\,[\boldsymbol{J}]$,
$\boldsymbol{k_E} = \mathbf{8.98755 \times 10^{9}}\,[\frac{\boldsymbol{N}}{\boldsymbol{C}^2}]$,
$\mathbf{1}\,[\boldsymbol{e}] = \mathbf{1.60217662 \times 10^{-19}}\,[\boldsymbol{C}]$

we obtain the result:

$$\boldsymbol{\Gamma_E} \approx \mathbf{1,0646 \cdot 10^{15}}\ [\boldsymbol{m}] \tag{4}$$

The unit of $\boldsymbol{\Gamma_E}$ is meters, as it is the integral of a dimensionless function over distance – see equation (2). We see that the rest mass of the electron is not arbitrary but results from well-known physical laws regarding potential fields, and with precise data, we can calculate it accurately. This applies to all other subatomic particles as well.

The question arises as to how to prevent the three like electric charges within the electron, which naturally repel each other, from dispersing. In Figure 1, we assumed *ad hoc* that the force between the touching electric charges is zero, but this would represent an unstable equilibrium. To stabilize the electron, we need to attach an elementary strong anticharge to each elementary charge of $-\frac{\mathbf{1}}{\mathbf{3}}\,[\boldsymbol{e}]$: anti-red, anti-green, and anti-blue. It is assumed that three different color charges or anticolor charges attract each other. This attractive force at zero distance must be finite and greater than any potential finite repulsive force between the touching, like electric charges. In strong interactions, a function similar to the electric interaction function (1) applies, which we will denote as $\boldsymbol{f_S(r)}$, and the strong interaction coefficient as $\boldsymbol{k_S}$. The range of the $\boldsymbol{f_S(r)}$ function is limited, as the strong interaction is a short-range force.

Why should anticolor charges, rather than color charges, exist in the electron? This is because it has been assumed that the proton is stabilized by color charges. It seems logical that the white color charge of the proton, together with the white anticolor charge of the electron, forms additional bonds between color–anticolor charge pairs at very close distances. Since it is the electrons that, through the strong interaction, bind protons within atomic nuclei, and given the convention that the proton contains a white color charge, the electron should contain a white anticolor charge.

The potential energy of the three touching, different anticolor charges is zero. However, attempting to split the electron causes these anticolor charges to move apart, and the electron transitions into excited states: muon, pion, tauon, W-boson, etc., gaining additional rest mass from the strong field potential. In this scenario, **the entire array of unstable subatomic particles produced in accelerators would be merely excited states of two stable composite particles: the electron and proton, along with their antimatter counterparts**. Just as an excited atom has a greater rest mass than an atom in its ground state, an excited electron or proton has a greater rest mass than in its ground state. The nature of the strong interaction makes it practically impossible to split a proton or electron; in any case, this is currently beyond the reach of our accelerators.

Note: A free neutron is a composite of a proton and an excited electron. The rest mass of the neutron is greater than the sum of the masses of a free proton and an electron, which is why the neutron is unstable and, on average, decays into a proton and an electron after about 15 minutes.

It is important to recognize that in all collisions in accelerators, only the basic stable composite particles (fermions), namely electrons, positrons, protons, and antiprotons, as well as (bosons) neutrinos and photons, are ultimately produced. Positrons and antiprotons quickly undergo annihilation if they are not separated from matter. In high-energy collisions at the LHC accelerator, we encounter a large number of electrons, positrons, protons, and antiprotons excited at various energy levels, along with conglomerates of these excited particles in various configurations, which accounts for the vast number of unstable subatomic particles observed. All these excited particles produced in accelerators descend through successive excitation levels to eventually reach their ground state. Numerous annihilations occur during this process. The high-mass subatomic particles generated at the LHC (high excitation levels), which also exist as pairs of excited particle – excited antiparticle combinations (such as the so-called Higgs boson), appear extremely rarely.

Note: Neutrinos do not have rest mass, as they have never been observed moving at speeds measurably less than c. Therefore, they should be classified as massless bosons, similar to photons for electromagnetic interactions, serving as energy quanta for nuclear interactions. The claim that neutrinos have rest mass is not supported by any experiment. If they did have rest mass, *they would not be able to move at the speed of light, and there would be a full range of various neutrino speeds. Moreover, the annihilation of a neutrino with an antineutrino has never been observed. To account for this, various strange (metaphysical) theories are again being "invented." As a massless particle, a neutrino does not have an antiparticle and therefore cannot carry any interaction charge.*

Another misguided idea is the concept of the weak interaction. (It was one of the earliest ideas in quantum mechanics, and the first ideas are not always the best ones.) As research progressed, the weak interaction began accumulating various strange features, making it increasingly divergent from other interactions (becoming progressively more metaphysical). It operates according to entirely different rules compared to other interactions: 1. The weak interaction (unlike others) propagates at a speed slower than the speed of light and is carried by massive bosons. 2. Weak interaction charges do not form potential fields and do not contribute to rest mass like other interactions. 3. The weak interaction led to the introduction of a metaphysical entity called the Higgs field. 4. The weak interaction is associated with the illogical postulate of parity asymmetry. 5. The idea of "flavor changing" is also illogical.

The transformation of one elementary particle into another (flavor change) lacks any practical or theoretical justification. Why would Nature (or God) do such a thing? Furthermore, this bizarre idea is widely promoted not only regarding the weak interaction. For example, all mesons decay into the lightest meson, the pion $\boldsymbol{\pi}$, which is considered a first-generation quark-antiquark pair. For instance, the negative pion $\boldsymbol{\pi}^-$, depicted as a $\boldsymbol{d\overline{u}}$ quark-antiquark pair according to current theory, decays into a negative muon and a muon antineutrino, or into an electron and an electron antineutrino, sometimes also emitting a photon.

Here, we see that two elementary particles from the quark group disappear, while two elementary particles from the lepton group appear in their place, without any annihilation or particle-antiparticle pair creation process. This conflicts with the postulate that any elementary particle can only be created or destroyed in pairs with its antiparticle. Here, we observe a sort of double flavor change occurring at the exact same moment, accompanied by an unprecedented shift in group: quarks transform into leptons. Additionally, it's challenging to determine which quark changes into the muon or electron and which becomes the antineutrino. The process by which fractional electric charges supposedly combine into a single elementary charge, such as that of the muon or electron, also remains unknown. It is worth noting that the muon and electron are considered elementary, indivisible particles.

The entire pion decay process appears illogical, contrived (metaphysical), and lacks theoretical justification. Therefore, the hypothesis that the $\boldsymbol{\pi}^-$ pion, as well as the $\boldsymbol{\mu}^-$ muon, are excited states of the electron seems more convincing – especially as it eliminates the irrational notion of parity symmetry violation within the world of elementary particles. It is as if with our right hand raised, we saw in the mirror that we were raising our left hand. It is metaphysics in its purest form.

Of course, alongside the strong interaction, there is a second short-range nuclear interaction, accompanied by a potential force field generated by the charges of this interaction. Let's call it, for example, the baryonic interaction, which, like the electric interaction, has two types of charges denoted by plus and minus. The charge of this interaction will be called the baryonic charge. Let us denote the unit of baryonic charge quantity with the symbol $[\boldsymbol{br}]$ (baryon) and assume that the elementary baryonic charge is $\frac{1}{3}\,[\boldsymbol{br}]$. Like electric charges of the same sign, baryonic charges of the same sign repel each other. In the baryonic interaction, we have a force formula similar to equation (1), but here it involves the function $\boldsymbol{f_B(r)}$ and the coefficient $\boldsymbol{k_B}$.

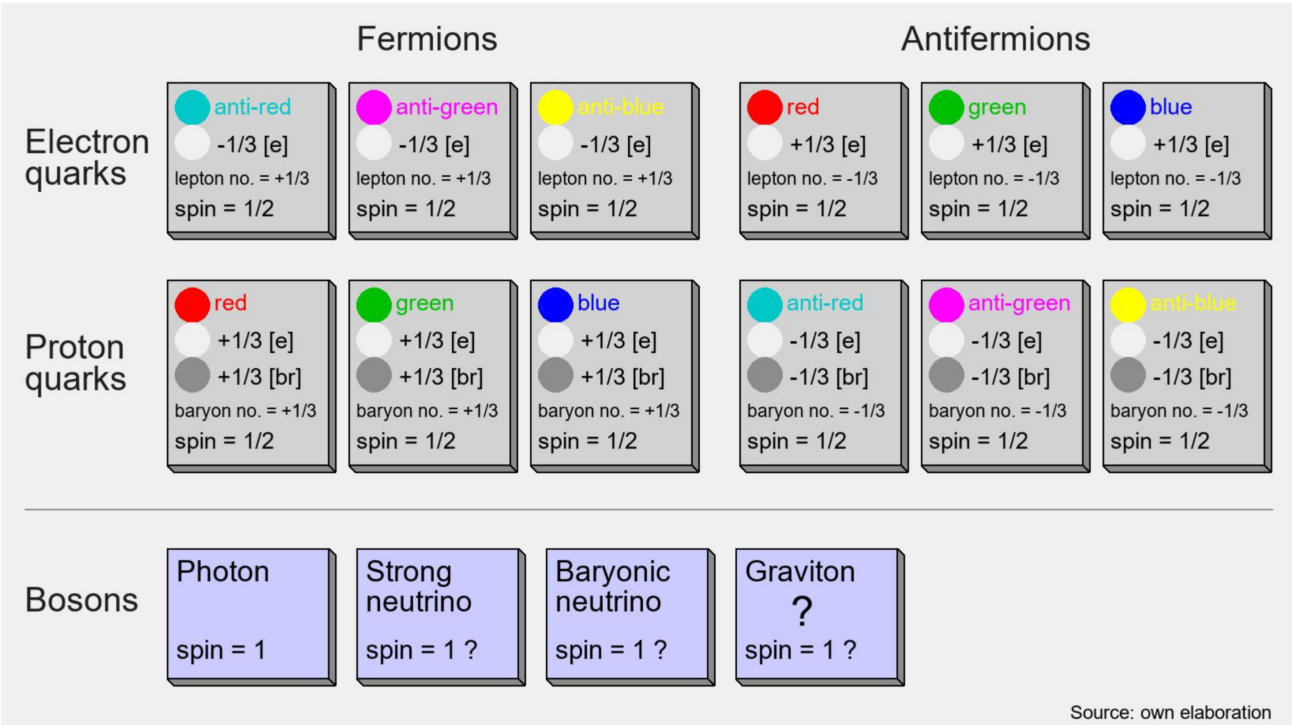
According to this concept, the electron consists of three elementary particles (let's call them electron quarks), each containing one elementary negative electric charge and one elementary strong anticharge, each in a different color. Meanwhile, the proton also consists of three elementary particles (let's call them proton quarks), each containing one elementary positive electric charge, one elementary strong charge, and one elementary baryonic charge. Let's denote the elementary baryonic charge in the proton as positive and in the antiproton as negative, so the proton contains $+\mathbf{1}\,[\boldsymbol{br}]$ of baryonic charge, while the antiproton has $-\mathbf{1}\,[\boldsymbol{br}]$.

The mutual repulsive force between like-sign baryonic charges at zero distance is greater than the attractive force between strong charges of different colors. Therefore, the elementary particles of the proton in its ground state are somewhat separated from each other, resulting from an equilibrium state between the strong, baryonic, and electric interaction forces (the proton is not a point particle). Thus, the proton's rest mass is composed mainly of the potential fields of the strong and baryonic interactions, with the electric field potential contributing to a lesser extent.

Nuclear interactions, like the electric interaction, should have their own energy quanta, massless bosons similar to photons. Let's call these bosons strong neutrinos and baryonic neutrinos. They are generated, similarly to photons, in situations where an excited electron or proton would transition to lower energy states. We assume that the functions $f_S(r)$ and $f_B(r)$ can also cross zero multiple times, just as the function $f_E(r)$ does.

Below is a proposal for a complete set of elementary particles in a revised version of the Standard Model (after applying Occam's razor). For fermions, the proper meaning of the term "elementary particle" has been restored here. An elementary particle, true to its name, is a stable object, meaning it does not decay, does not change flavor, does not exchange charges with other particles, and can only be destroyed through annihilation with its antiparticle.

Bosons can be created and absorbed only by the charges of their respective interactions; therefore, baryonic neutrinos do not interact with electrons and positrons (they do not collide with them). In the presented concept, bosons are not carriers of interactions but rather transfer energy and momentum over a distance.



The Achilles' heel of modern physics is the lack of an answer to the question of what mass is. The introduction of the Higgs field concept has not helped clarify this issue; on the contrary, it has complicated it by introducing yet another unnecessary metaphysical entity. There are no experiments or observations that confirm the existence of the Higgs field. The fact that at the LHC some exotic subatomic particles appear on average once in a billion collisions, only to immediately decay into basic components of matter, which ultimately annihilate, proves nothing.

There is no precise mathematical model or formulas that explain how the

Higgs field gives mass to individual particles (e.g., electrons) and why it gives them a specific amount. Saying that the Higgs field provides particles with some kind of "resistance," which translates to their mass, along with the naive story about Mrs. Thatcher and a crowd of reporters, cannot be called physics. Mass is not "resistance"; it is energy. Physics is an exact science, not a weaving of fairy-tale visions.

Note: Rest mass is solely potential energy, and potential energy exists exclusively in the form of rest mass. Simply put, rest mass and potential energy are synonyms. For example, when we lift an object from the floor, we increase its rest mass according to the equation $\boldsymbol{E = mc^2}$. *When we compress (or stretch) a spring, we increase its rest mass. A free electron near an electrode charged to -511[kV] has a rest mass twice as large as it would at zero electric potential, and so on.*

What was presented above about the electron's rest mass is based on well-known and confirmed laws of physics. The Higgs field is entirely unnecessary here. The Higgs field was "invented" to explain the mass of the $\boldsymbol{W^-}$, $\boldsymbol{W^+}$ and $\boldsymbol{Z}$ bosons. But it would be simpler to assume that $\boldsymbol{W^-}$ and $\boldsymbol{W^+}$ are an excited electron and an excited positron. Meanwhile, the $\boldsymbol{Z}$ boson would be a newly formed pair – an excited electron and an excited positron – that lacks sufficient kinetic energy to separate. However, dropping to a lower excitation level (tau-antitau, muon-antimuon) or to the ground state (electron-positron) allows the pair to gain enough kinetic energy to separate.

In light of the above, one could conclude that instead of spending large amounts of money to keep the LHC operational and planning the construction of an even larger and more expensive accelerator, efforts should focus on modifying the Standard Model rather than stubbornly seeking confirmations of its correctness. According to the presented concept, the neutron, as a combination of a proton and an excited electron, has an integer spin. Therefore, the spins of atomic nuclei with an odd atomic number are half-integer (they are fermions), regardless of mass number. Conversely, the spins of atomic nuclei with an even atomic number are integer (they are bosons). Thus, the spin of a deuterium nucleus is not integer, as previously thought, but should be half-integer. It would be sufficient to design a precise experiment to verify this, without involving the LHC.

The same applies to the helium-3 isotope (^3He), where, according to the current theory, it is assumed to have a half-integer spin rather than an integer spin. Evidence that the ^3He isotope has an integer spin lies in the fact that it can exist in a superfluid state, just like helium-4 (^4He), meaning it is a boson capable of forming a Bose-Einstein condensate. (The Bose-Einstein condensate applies only to bosons.) Attempts to explain that ^3He, as a fermion with half-integer spin, can exist as a Bose-Einstein condensate are highly speculative and illogical (metaphysical).

In the 1920s, the quantum theory of the electromagnetic field (QED) began to be developed. Associated with this theory are the so-called Feynman diagrams. QED is a theory that contradicts classical physics, including Special Theory of Relativity (STR), even though QED was supposed to ensure the compatibility of quantum mechanics with STR. In Feynman diagrams, situations are allowed where an electric charge interacts with itself. (A photon emitted by, for example, an electron, according to QED, can be absorbed by the same electron. However, according to STR, an electron cannot catch up with a photon it emitted, as it moves slower than the speed of light.)

In QED, it is assumed that electric interactions are mediated by so-called virtual photons. The term "virtual photon" originates from the formalism of quantum field theory, where electromagnetic forces are described through the exchange of photons – the carriers of these forces. However, this terminology can be confusing, as it may suggest that a virtual photon behaves like a real one, which is not true. Virtual photons are merely "computational tools" (information carriers) in calculations related to the exchange of information between particles, rather than actual particles that carry energy. The information carried by virtual photons is much richer and more complex than the information (physical parameters) contained in real photons.

A "virtual photon" must, above all, contain precise data about the charge that emitted it. This includes the charge's value, position, and data on the velocity and acceleration vectors of this charge. To specify this information, it is necessary to impose a coordinate system on spacetime (U-space). With this data, along with information about the charge (the charge value, its position, and velocity vector) that is subject to interaction, calculations can be performed according to physical laws to determine, primarily, the acceleration vector of the given charge. This allows for the determination of velocity changes in the immediate future (in the next time quantum) and, based on this, the progression of the charge's worldline can be calculated. Simply put, based on past information about electric charges located on the four-dimensional hypersurface of the light cone of a given charge, the resultant electric field at the point where it is located is determined, and from this data, the further progression of its worldline is calculated. This implies that the electric field is also merely information. We do not directly observe the electric field, only the effects of its influence.

Of course, such a classical approach to electric interaction applies to situations involving macroscopic distances (e.g., in experiments with electrostatic or magnetic fields, in electric motors, in cathode ray tubes, or vacuum tubes, etc.). These are situations where we can neglect the quantum nature of space, time, and all other physical parameters. However, at subatomic distances, where we cannot ignore the fact that physical parameters are not continuous, we then apply quantum mechanics, which also must align with classical physical laws but in a statistical manner. The concept of the wave function works excellently here, as it very accurately predicts the results of experiments within the domain of quantum mechanics.

The fact that the wave function describes reality so accurately on the micro scale has certain implications for classical physics. First and foremost, the principle of information conservation has been invalidated. This principle originated in the Newtonian era, when it was imagined that the world was deterministic due to the reversibility of all classical physical laws. (Note: When physical laws are reversible, the current state can reveal not only the entire past but also predict the entire future.) In quantum mechanics, however, we encounter indeterminism, where the collapse of the wave function is a random process, resulting in the loss of any ability to reconstruct the state prior to measurement. It is important to remember that each interaction between two particles involves the collapse of the wave function of each particle, meaning a measurement is effectively taking place.

Nature performs countless measurements on itself. When an object is illuminated, for example, by sunlight, trillions or more photons hit it every second. This results in trillions of interactions (measurements) between photons and the electrons of outer atomic orbitals in the paint covering the object. As a result of these interactions (measurements), trillions of new photons (new wave functions) are generated, with frequencies depending on the paint's color. Some of these photons enter our eyes, leading to millions or billions of additional interactions with the retina, and so on. Each interaction involves the collapse of wave functions and the loss of information about the past states of the particles involved. Someone might argue that the wave function is reversible (deterministic). Yes, but only until the moment of its collapse. After the collapse, information about the shape of the function is lost irreversibly.

If the principle of information conservation held in the strictest sense, we would be dealing with complete determinism, which contradicts the probabilistic nature of quantum mechanics. Determinism (i.e., the principle of information conservation) would mean that we have no free will, as all our decisions would be predetermined. What an absurdity. Thus, the uncritical transfer of the classical principle of information conservation to quantum physics is a serious mistake.

Let us now address Heisenberg's uncertainty principle. This principle originally concerned measurement limitations and how precisely we can measure certain pairs of variables (e.g., position and momentum). Heisenberg formulated it in the context of observation, suggesting that attempting to measure one of these quantities accurately disturbs the other, making it an issue related solely to the observer. However, over time, this principle was interpreted more broadly, relating to the nature of reality itself, not just measurement limitations. This broader interpretation led to the concept of vacuum fluctuations as a consequence of the uncertainty principle for energy and time. The argument is that the uncertainty principle for the energy-time pair allows for temporary energy disturbances that can "borrow" energy from the vacuum for a short time, creating particle-antiparticle pairs before disappearing again. Such fluctuations are allegedly consistent with the conservation of energy because these particles exist only for a very brief time (short enough that they cannot be "measured" in a classical way).

Such an interpretation of Heisenberg's uncertainty principle, where Nature lacks access to precise parameters of a particle, contradicts the concept of the wave function. The wave function is deterministic, meaning it operates on strictly defined physical parameters, including energy and time. The wave function starts from a point in configuration space with precisely defined parameters, with no ambiguity. Then, the wave function spreads over an increasingly larger area of configuration space. Each point in this space has strictly defined physical parameters and a probability value. There is still no indeterminacy here. When an interaction (measurement) occurs, a point in configuration space is selected, where all parameters are precisely determined. Indeterminacy is still absent. If Nature's calculations were based on undefined data, the laws of physics would cease to function. Therefore, in the configuration space of particle wave functions, quantum fluctuations cannot occur, and thus there are no such fluctuations in a vacuum. It is impossible to describe such fluctuations with a wave function, as the energy at the starting point of the wave function must come from another particle, not from the vacuum. Quantum physics cannot disregard the conservation of energy. Conservation laws are, in fact, fundamental for analyzing all quantum effects in accelerators. This reveals another inconsistency, where the energy conservation principle is applied at the quantum level at one moment and ignored at another.

To be thorough, it should be noted that, in the case of the wave function, there is indeed a form of breaking conservation laws. The configuration space of the wave function is discontinuous (discrete), so parameter values are not continuous. To fully satisfy conservation laws of momentum, energy, etc., we would need a continuous configuration space. Thus, each measurement (the selection of a specific point in the discontinuous configuration space) may slightly violate these fundamental conservation laws. And here we see the remarkable wisdom of Nature (God). If instead of random selection, the point with the highest probability were chosen (the point closest to where the conservation laws are exactly met), errors could accumulate in one direction, resulting in a visible cumulative error at the macroscopic scale. Random selection ensures that statistically, this cumulative error remains consistently low. The fact that conservation laws are often slightly violated in individual measurements is perfectly masked by Heisenberg's uncertainty principle for us as observers. This approach suggests that randomness is a fundamental feature of the quantum world, but it does not imply that this world operates "chaotically"—quite the opposite. Randomness prevents the accumulation of errors and ensures that the laws of physics remain coherent on a large scale. Suggesting that Nature (contrary to the principle of energy conservation) has created chaos in the vacuum in the form of a sea of fluctuations makes no sense. Nature operates logically and consistently, in accordance with the principles it has set for itself. It does not bring unnecessary (metaphysical) entities into existence.

Let's now move from the micro to the macro scale. In cosmology, there has recently been a significant rise in various metaphysical entities, such as singularities, baryogenesis, cosmic inflation, dark matter, dark energy, the multiverse, etc. Why should these be considered metaphysical entities? Because they aren't described by any models or mathematical formulas. There's no direct evidence for their existence. (Typically, the validity of a hypothesis is tested experimentally after building a mathematical model with the full mathematical apparatus. Then, based on mathematical equations, certain behaviors of this model are predicted, which are checked to see if they align with experiments.) Unfortunately, for the hypotheses mentioned above, there are no mathematical models that align with the principles of physics, nor are there any concepts for what such models should look like, and we lack instruments (detectors) capable of investigating these metaphysical entities.

To resolve this deadlock, we need to address the root of the problems. The issues above and many others related to cosmology arose because, to "rescue" existing theories and paradigms that began to falter under the pressure of new observations and experimental results, completely new metaphysical entities, unknown to physics and inconsistent with established physical laws, were "invented" to "patch up" flawed theories. This pertains mainly to the Big Bang theory, which is inspired by general relativity. Both theories require a thorough revision, as continuing to treat these theories as unquestionable (as if they were revealed truths) will lead modern physics to "tread water" and continue accumulating metaphysical entities.

Let's first take a look at the general theory of relativity (GR). In 1907, Einstein formulated the equivalence principle. (He later called it "the happiest thought of his life," as it was a breakthrough in his work on general relativity.) According to this principle, in a freely falling elevator, a beam of light passing from one wall to the other won't curve upward relative to the elevator along a parabolic path due to the elevator's acceleration, as Newtonian physics would predict. Instead, it will move in a straight line toward the opposite wall, as if the elevator were an inertial reference frame. Based on the equivalence principle, Einstein argued that this upward deflection wouldn't occur because, in a gravitational field, the light beam would curve by exactly the same amount, but in the opposite direction.

However, after Einstein formulated the final equation for GR, calculations revealed that the deflection of a light beam in a gravitational field is twice as large as what would be expected based on acceleration and Newton's law. Thus, in a freely falling elevator, according to GR, the light beam ultimately deflects downward. This means that an observer in a windowless elevator can determine whether they are in an inertial frame somewhere in a gravity-free void or freely falling within a gravitational field. By simply measuring the curvature of light, they can determine their situation. If the light curves in a certain direction, they will conclude, per GR, that they are in a gravitational field and freely falling toward that curvature. On the other hand, if no light deflection is detected, they can deduce they are in an inertial frame outside of any gravitational fields. This implies that **GR undermines the equivalence principle**, upon which it was built.

The initial version of Einstein's field equations included a coefficient of 4π in the field equation, rather than the 8π found in the current formulation. It looked like this:

$$\boldsymbol{G_{\mu\nu} = \frac{4\pi G}{c^4} T_{\mu\nu}} \tag{5}$$

With this version of Einstein's equation, everything aligned. In a freely falling elevator, a light beam passing from one wall to the other, according to the above formula, would travel in a straight line. However, this did not match the precise calculations for the perihelion shift of Mercury's orbit. To make the formula fit Mercury's orbit, Einstein changed the coefficient to 8π. The final form of the equation, which we know today, is:

$$\boldsymbol{G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}} \tag{6}$$

There was only one problem: While the coefficient 4π in formula (5) has a geometric justification, as it represents the surface area of a sphere with a radius of 1, the coefficient 8π in formula (6) has no such justification. (One could at best say it represents the surface area of two spheres.) Through this manipulation with the coefficient, Einstein invalidated the equivalence principle. (He probably thought, "Maybe no one will notice?" And he was right. So far, no one has noticed.) Einstein made this change in the formula in 1915. Earlier, in 1914, Arthur Eddington was planning his first expedition to regions of total solar eclipse to measure the bending of light rays, when formula (5) was still being considered, but due to the outbreak of World War I, the expedition did not take place. Eddington was finally able to carry out such measurements during a total solar eclipse in 1919, and indeed confirmed that light bends according to formula (6). However, there remains one doubt. These measurements were interpreted as if there were a perfect vacuum around the Sun. The phenomenon of refraction in the Sun's atmosphere was not considered. Artificial intelligence, when asked to estimate this effect, tried hard to minimize the influence of this phenomenon, but still concluded that at least 20% of the measured light deflection came from refraction in the Sun's atmosphere.

Now let's move on to the analysis of Mercury's perihelion motion. Even before the development of General Relativity (GR), astronomers, through many years of observing Mercury's orbit, identified a movement in the perihelion of this orbit. (Current, highly accurate measurements indicate that this perihelion shifts by 574.10 ± 0.65 arc seconds per 100 years.) As early as the 19th century, it was recognized that when calculating Mercury's orbital precession using Newtonian physics, including the influence of other planets, there was a shortfall of several tens of arc seconds compared to the observed result. Calculations based on Newton's "non-binding" formulas estimate that the gravitational influence of other bodies in the Solar System on Mercury's perihelion shift amounts to 532.3035 arc seconds. Thus, the missing angle is estimated at approximately 42 arc seconds. Using GR formulas, when applying an isolated Sun-Mercury system model, the result obtained is around 43 arc seconds. For such an isolated system, Newton's formulas do not predict any perihelion motion. Therefore, the absolute error for the isolated Sun-Mercury system, when calculated using Newton's "incorrect" formulas compared to the result from GR's "correct" formulas, is 43 arc seconds. So what might the error be from using Newton's "incorrect" formula when considering all the planets in the Solar System? This error will certainly be much greater than 1 arc second, which is roughly the difference between the missing angle and the result from Einstein's formula. This error cannot be calculated using Einstein's formula, as the equations of GR do not allow for an analytical calculation of the trajectory (orbits) in a three-body system, let alone the entire Solar System.

Calculating 92.7% of Mercury's perihelion shift using the "faulty" Newtonian formulas and only 7.3% with the "correct" GR formulas is the same kind of manipulation as replacing 4π with 8π. For Mercury's perihelion shift to be proof of the validity of Einstein's formula, it should have been calculated using GR formulas with consideration of the entire Solar System. (Unfortunately, as mentioned above, GR's formulas are not suitable for such calculations.) The agreement with observations was achieved by calculating Mercury's perihelion shift using two completely different methods, where the majority of the shift was computed with the "incorrect" Newtonian formula. This is a strong argument suggesting that GR is a flawed theory. It should be recalled that this "accidental agreement" was achieved by manipulating the coefficient on the right side of Einstein's equation.

We need to face the truth. Neither Newton's formula nor Einstein's formula can explain the anomaly in Mercury's orbit. Furthermore, there are other anomalies observed in the Solar System for which both theories are powerless. These include the Pioneer anomaly, the flyby anomaly, the anomaly in the orbit of the asteroid Apophis, and the anomaly in the trajectory of the object from outside the Solar System, 1I/'Oumuamua. In this situation, instead of creating a flawed (non-physical) theory that doesn't explain any anomalies in the Solar System and with which practically nothing can be calculated accurately, we should have simply made a slight modification to Newton's law of universal gravitation, just as we modified Coulomb's law. The equivalent of formula (1) for gravitational interaction is:

$$\boldsymbol{F = k_G m_1 m_2 f_G(r)} \tag{7}$$

where $\boldsymbol{f_G(r)}$ is a dimensionless function of distance, which deviates slightly from Newton's function $\boldsymbol{1/r^2}$ at distances on the scale of the Solar System. However, at intergalactic distances, the original function $\boldsymbol{f_G(r)}$ diverges significantly from Newton's function. This is evidenced by the velocities of galaxies in clusters as well as the velocities of stars at the edges of galaxies. In this way, we immediately eliminate the completely unnecessary and mysterious (metaphysical) entity known as dark matter.

Newton's function $\boldsymbol{1/r^2}$ also does not apply at laboratory-scale distances. This is suggested by occasional reports of variations in the gravitational constant when a laboratory attempts to re-measure it precisely. This variability, which exceeds the estimated range of measurement error, arises because the studies of force between test masses were conducted at different distances $\boldsymbol{r}$. Therefore, the gravitational constant measured in the laboratory can differ significantly from its value when the original function $\boldsymbol{f_G(r)}$ is approximated by $\boldsymbol{1/r^2}$ for distances ranging from the Earth's radius to the Solar System's radius. Thus, when determining the masses of the Earth, Sun, and other celestial bodies based on the gravitational constant measured in laboratory conditions, we cannot ascertain the magnitude of the error we are making, nor do we know the direction of this error—that is, whether we are overestimating or underestimating their masses.

The unification of all interactions means that they operate always and everywhere based on the same unified rules, regardless of temperature conditions. We have two long-range interactions, namely the electric and gravitational, and two short-range nuclear interactions—the strong and baryonic. All these interactions function in a flat four-dimensional spacetime (U-space), where special relativity holds, meaning that all interactions propagate at the speed of light. Thus, a given object is influenced only by remote interactions originating from objects located on the hypersurface of its four-dimensional past light cone.

Interactions have their specific charges that generate potential vector fields, where the remote force between two charges of a given interaction is proportional to the product of the charges multiplied by a dimensionless distance function, $\boldsymbol{f_E(r)}$, $\boldsymbol{f_S(r)}$, $\boldsymbol{f_B(r)}$, and $\boldsymbol{f_G(r)}$, corresponding to the electric, strong, baryonic, and gravitational interactions, respectively, and further multiplied by the appropriate interaction coefficient. These coefficients are: $\boldsymbol{k_E}$, $\boldsymbol{k_S}$, $\boldsymbol{k_B}$, and $\boldsymbol{k_G}$. This is precisely the basis of interaction unification: they all share the same formula for the force one charge exerts on another. The functions $\boldsymbol{f_E(r)}$, $\boldsymbol{f_S(r)}$, and $\boldsymbol{f_B(r)}$ pass through zero multiple times at subatomic distances, creating local potential minima. These local minima are what led to the formation of the periodic table, with its 92 naturally occurring chemical elements. (Some of these elements are unstable but have very long half-lives.) Meanwhile, the gravitational function $\boldsymbol{f_G(r)}$ is shaped in a way that facilitates and accelerates the formation of galaxies.

Everything that occurs in the Universe – stellar evolution, the formation of galaxies, all of chemistry, radioactive decay, biological life, and so on – arises from a single principle: **the principle of minimum potential energy**, or in other words, **the principle of minimum rest mass**. All interactions (forces) in Nature are based on this one principle. Why has the Universe not yet reached its minimum rest mass? That is, zero mass if there is a balance between matter and antimatter, or, in the absence of such balance, a minimum in the form of a single global black hole. Firstly, this results from initial conditions, and secondly, on the path to a global minimum, there are numerous local minima, as illustrated in Fig. 1. These appropriately distributed local minima, meaning suitably shaped functions $\boldsymbol{f_E(r)}$, $\boldsymbol{f_S(r)}$, and $\boldsymbol{f_B(r)}$, determine the structure of the periodic table and the evolution of the Universe. They are precisely what encoded life into the periodic table and created conditions for life to emerge in the Universe. Life in the Universe can be a very common phenomenon. However, the inexorable laws of thermodynamics will eventually lead the Universe to reach its minimum rest mass, that is maximum entropy. Thus, just as the Universe had a beginning, it will also have an end.

It seems that general relativity (GR) has caused as much harm to classical physics as the concept of weak interaction has to quantum physics. If we apply only special relativity (SR) to cosmology, excluding GR, issues such as dark energy and the Hubble tension disappear immediately. Gravitational waves are not ripples in spacetime, but rather a gravitational version of synchrotron radiation. Gravitational lensing is simply optical lensing. Event horizons vanish, and black holes become just another state of matter with extremely high but finite density, and so on. All the above topics (and more) are thoroughly discussed and supported with derived mathematical formulas in the book „The New Applications of the Special Theory of Relativity".

Bibliography

- **Kragh, H. (1996).** *Cosmology and Controversy: The Historical Development of Two Theories of the Universe.* Princeton University Press.
- **Hossenfelder, S. (2018).** *Lost in Math: How Beauty Leads Physics Astray.* Basic Books.
- **Ellis, G. F. R., & Silk, J. (2014).** *Scientific Method: Defend the Integrity of Physics.* Nature, 516(7531), 321–323.
- **Smolin, L. (2006).** *The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next.* Houghton Mifflin.
- **Penrose, R. (2005).** *The Road to Reality: A Complete Guide to the Laws of the Universe.* Alfred A. Knopf.
- **Bohm, D. (1952).** *A Suggested Interpretation of the Quantum Theory in*

Terms of "Hidden" Variables I and II. Physical Review, 85(2), 166–193.

- **Pope, C. N., & Townsend, P. K. (1983).** *Quantum Cosmology and Particle Physics.* Annals of Physics, 158(1), 1–25.
- **Dicke, R. H. (1961).** *Dirac's Cosmology and Mach's Principle.* Nature, 192(4801), 440–441.
- **Bekenstein, J. D. (1973).** *Black Holes and Entropy.* Physical Review D, 7(8), 2333.
- **Feynman, R. P. (1987).** *QED: The Strange Theory of Light and Matter.* Princeton University Press.
- **Weinberg, S. (1977).** *The Search for Unity: Notes for a History of Quantum Field Theory.* Daedalus, 106(2), 17–35.
- **Aad, G., et al. (ATLAS Collaboration). (2012).** *Observation of a New Particle in the Search for the Standard Model Higgs Boson with the ATLAS Detector at the LHC.* Physics Letters B, 716(1), 1-29.
- **Steinhardt, P. J. (2011).** *The Inflation Debate: Is the Theory at the Heart of Modern Cosmology Deeply Flawed?* Scientific American, 304(4), 36-43.
- **Sakharov, A. D. (1967).** *Violation of CP Invariance, C Asymmetry, and Baryon Asymmetry of the Universe.* JETP Letters, 5, 24-27.
- **Agostini, M., et al. (2020).** *Comprehensive Analysis of Neutrino Oscillation Physics Using Reactor and Accelerator Data.* Physical Review Letters, 125(10), 101802.
- **Pastuszek, Tadeusz. (2023)** *The New Applications of the Special Theory of Relativity.* Abacus Publishing House, Bielsko-Biała.