

The higgs boson and the resonances at the Large Hadron Collider

Abstract

The article presents experimental discoveries recently obtained at the Large Hadron Collider (LHC) and at the Alpha-magnetic spectrometer AMS-02, which was placed on the International Space Station (ISS). To explain their results, it is proposed to consider the polarization of quantum vacuum (dark matter) and the resonances accompanying the formation of unstable particles, including heavy resonances of the Higgs boson, in collisions of bundles of relativistic protons. In this connection, it is necessary to reconsider the Standard Model.

Keywords: vacuum, dark matter, proton, electron, positron, resonance, mass, energy

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Introduction

The experimental discoveries made recently at the Large Hadron Collider (LHC) include the discovery of the Higgs boson, the increase in the proton interaction cross-section with increasing energy, and the increase in the fraction of the elastic scattering processes in the interval the energy $Wp \sim 100 \text{ GeV} - 13 \text{ TeV}$ that is, the effect an increase in stability the protons as well as the emission of jets in inelastic processes with a large multiplicity.¹ The most striking is that the interval of resonant proton energy in the LHC, at which is observed the greatest probability of inelastic collisions of protons and the creation of new particles, corresponds to the energy interval $Wp \approx 10 - 100 \text{ GeV}$,¹ however, with increasing energy of relativistic protons, the effect of their stability after collision increases.¹ Noteworthy is the fact that that in the alpha-magnetic spectrometer AMS-02, the resonance maximal of the total energy spectrum of the secondary electrons and positrons,² as well as the maxima of the energy spectra obtained separately for positrons² and for electrons² also corresponds to the energy interval $Wp \approx 10 - 100 \text{ GeV}$. It can be assumed that the creation of new particles in this energy range is associated with the polarization of a quantum vacuum (dark matter). Such a picture contradicts the notions of classical physics and goes beyond the framework of the Standard Model (SM). The last experimental discoveries in the LHC are waiting for an explanation. Their interpretation is difficult since all observed effects in LHC are associated with the manifestation of strong interaction forces and should be described by quantum chromodynamics (QCD). Today in theoretical physics, the perturbation theory method is used, in which expansions in power series are performed with respect to the coupling constant in the case of its small values. However, this method is not suitable for describing the production of particles at so-called "soft" events of interaction with small transmitted pulses, for which the coupling constant is sufficiently large. In the interpretation of experimental data on such events, models with a lot of adjustable parameters are usually involved. As a result, predictions of models become less certain and not reliable enough. The article offers a different interpretation of the "soft" events of the creation of unstable particles in the LHC on the basis the polarization of a quantum vacuum (dark matter) and the resonances. The creation

of unstable particles in the LHC at proton energies of the order of $10 - 100 \text{ GeV}$ is indeed observed,¹ as is the production of electron-positron pairs in the cosmic AMS-02 detector,² but this effect can be explained by the polarization of the quantum vacuum (dark matter), which is the third full participant in collisions of protons in the LHC and whose presence the apologists of the dominant 100 years in the physics of the Einstein's Special Relativity Theory (SRT) deny.³ Due to the fact that within the framework of the ELI and XCELS projects the laser radiation intensity available for experiments has increased to $10^{23} \text{ W.cm}^{-2}$ and higher, it has become possible to study the nonlinear vacuum effects that have so far not been experimentally studied. Thus, at the level of ultrahigh intensities $10^{23} \text{ W.cm}^{-2}$, the effect of scattering of a laser pulse on an electron beam with an energy of 46.6 GeV (nonlinear Compton effect) on the SLAC linear accelerator causes such cascades of successive hard-photon emissions ($W_{\text{phot}} = \hbar \nu$) that the creation of secondary electron-positron pairs in vacuum is a chain reaction that continues up to up to the moment of complete loss of energy by charged particles. This is very reminiscent of the extensive atmospheric showers generated by cosmic particles.^{4,5} In this comparison of space observations with the results of laboratory studies demonstrates the deep analogies, evidencing, at a minimum, the unity of the physical principles of the behavior of matter in a wide range of densities (approximately 42 orders of magnitude) and temperatures (10^{13} K). Perhaps the creation of electron-positron pairs in a vacuum is a manifestation of the instability of dark matter. Today, according to the results of experiments on the SLAC linear accelerator, many physicists believe that in the LHC the emission of jets in inelastic processes with a large multiplicity, including protons and antiprotons, is associated with dark matter.⁶ In the quantum electrodynamics (QED) there is still no complete clarity on how to solve the problem of the production of pairs of elementary particles and antiparticles in a vacuum under the action of external fields, relying on the corresponding equations the Klein-Gordon-Fock and the Dirac's equations. For some of these fields, it is possible to construct the corresponding quantum theory of the Dirac's field, but on the whole, there are insurmountable difficulties connected with the creation of electron-positron pairs from the vacuum leading to nonlinear many-particle problems.⁷

The polarization of a quantum vacuum (dark matter) and resonances

In quantum electrodynamics (QED), the instability of a physical vacuum under the influence of high-energy photons of cosmic radiation, relativistic protons, peak electric and magnetic fields or high-intensity laser radiation is called the vacuum polarization and is characterized by the formation of electron-positron pairs, which makes the vacuum itself unstable.⁸ In the LHC, the electric current arises from the motion of charged beams of relativistic protons and in accordance with Maxwell's equations, generates force and non-strong, toroidal and poloidal electromagnetic fields.⁹ It has been experimentally established that in the presence of a strong magnetic field $H \approx 10^{16} T$ or peak of the electric fields strength $E \approx 10^{16} V \cdot cm^{-1}$ in the quantum vacuum from virtual particles relatively stable particles are formed (lifetime $16 \cdot 10^{-23}$ sec.). With the polarization of the quantum vacuum and its transformation into the matter, the change in the energy of the vacuum w can be represented as a sum:

$$w = w^p + w^a \quad (1)$$

where w^p is the vacuum polarization, $w^p \ll E^2 / 8\pi$; w^a is the change in the energy of the substance at the production of particles

$$w^a = eET\aleph, \aleph = \frac{e^2 E^2 T}{4\pi^3} \exp\left(-\pi \frac{m^2}{\hbar E}\right)$$

The creation of particles is the main reason for the change in the energy of the vacuum. The small value of the reverse reaction w^p implies the limitation on the electric field E strength for a given time T ($Es \approx 10^{16} V \cdot cm^{-1}$ is the critical Schwinger's field).⁷ The direction of motion of secondary electron-positron pairs produced in the vacuum (dark matter) can be determined by the nature of effect that caused the polarization of the vacuum. Under the influence of rigid photons, the deformation of vacuum occurs in the transverse direction to the propagation of perturbation, which determines the direction of motion of electron-positron pairs (Figure 1A). This can be seen by analyzing the observation data on the fluxes of secondary electron-positron pairs with the soft energy spectrum in the quantum-dynamic cascades in an intense the laser field or in the near-Earth environment under the action of cosmic-ray photons in the PAMELA and AMS-02 experiments.² If the vacuum polarization is caused by the motion of relativistic charges or by the peak electric field strictly oriented in one direction, then the secondary electron-positron pairs produced in the vacuum will move in the direction opposite to the momentum of the primary charged particles, with zero the transverse momentum $\delta^{\perp} = 0$,⁸ since deformation the vacuum will occur in the longitudinal direction (Figure 1B). An experimental confirmation of this could be the appearance of a flow of backward electrons with a "soft" energy the spectrum in the multiwave Cherenkov generators (MWCG). One of the peculiarities of the work of MWCG using and the electron beam of microsecond duration with and the initial charged-particle energy $W_e \sim 2 MeV$ and the common current $I \sim 20 kA$ is the relatively short radiation pulse in the three-centimeter wavelength range with a of record high power level of up to 15 GW.¹⁰

The quantum vacuum is a global field of oscillators' super-positions with the continuum of frequencies. In contrast to the field, a particle oscillates with the same fixed frequency. In front of us, there is an example of the non-integrable Poincare system. Resonances will occur

whenever the frequency of the field and the particle are will coincide. The evolution of dynamical systems (the particles) up to the self-organized matter depends on available resonances between degrees of freedom. This was a conclusion by I. Prigogine and I. Stenger in their monograph the "Time, Chaos, Quantum".¹¹ They revived an idea by N. Tesla on a theory of global resonance. Nevertheless, if the Tesla's resonance theory of the matter birth in the ether had been based on an intuition of the ingenious experimenter, then in case of I. Prigogine, this theory acquired rigorous mathematical view. Proved by Poincare the non-integrable dynamical systems and the theory of resonant trajectories by Kolmogorov-Arnold-Moser allowed Prigogine to conclude that the mechanism of resonance interaction of particles in large-scale Poincare systems (LPS) was "essentially" mandatory and not probabilistic. With increasing communication parameters, there is an increase in the likelihood of resonance outcomes. It is such LPS dynamic systems, to which systems of particle interaction with the space environment and with each other belong. Nobel Prize winner I. Prigogine wrote, "If the systems are independent, then for coherence and self-actualisation, there would be simply no place as all dynamic movements would essentially be isomorphic movements of free (non-interacting) particles. Fortunately, the LPS in nature prevail over other systems."¹¹ In the general case, unusual virtual/real the particles changes are possible in a nonlinear oscillator even with sinusoidal external force applied. The can be very irregular and almost sporadic to the extent of dynamic stochasticity.¹² The behavior motion the particle with the isolated nonlinear resonance is similar to the behavior the electron in a potential well. Multiple the resonances correspond to multiple potential wells. Overlapping the resonances is indicative of a convergence of adjacent wells with; a particle can pass from the well into the well and, under certain conditions, leaving the wells. Let us consider in more detail this the mechanism. In the case of a linear oscillator, one can manage with the first term of the expression $\omega^2(x) = \omega_0^2 + \alpha x + \beta x^2 + \dots$ and the only fundamental effect observed when the external periodic force is applied is a linear response. In this case, the smaller the oscillator loss, the sharper and higher the resonance curves. What will change if the oscillation frequency depends on the amplitude? Let the frequency of the external force be equal to the frequency of rotation of the particle along one of the phase trajectories. Then the system will then draw energy from the outside and the initial low oscillations will grow. The particle will therefore gradually move to higher-energy of the phase trajectories but since the oscillator is not isochronous, to the higher energies will correspond a different frequency. As a result, the system runs out of resonance and beginning with certain amplitude, the oscillator ceases to respond to external force. Thus, the way out of resonance occurs at the expense of is due to nonlinear the shift the frequency $\omega = \omega(x)$. Consider now the case of a nonlinear oscillator. In a linear oscillator, resonance only occurs at a frequency close intrinsic, i.e. $\Omega = \omega_0 \pm \varepsilon$, where ε is a small addition. For a nonlinear oscillator there are additional resonances on the harmonics; e.g. quadratic nonlinearity activates spectral components $2\Omega, 4\Omega$, etc. (anharmonicity of vibrations). Therefore, if for example $2\Omega = \omega_0$, then the system will with the resonance on the harmonic of the external force. In the system arises the regime arises a dynamic stochasticity. Whereas the behavior the particle in an oscillator is generally interpreted as fully deterministic, with its past and future explicitly determined by equations of motion and initial conditions, stochasticity is associated with randomness and ambiguity.¹² Could a strictly deterministic process also appear as random? L.Sapogin in his the Unitary Quantum Theory (UQT) answers in the affirmative.

His physical and mathematical investigations demonstrate that it is possible and, in some cases, inevitable. In solving the problem of the harmonic oscillator, in addition to conventional stationary oscillations of a charge with a discrete value of energy professor Lev Sapogin offers are two new the solutions (Figure 2), which were named by him “Crematorium” and “Maternity Home”. In the first decision the particle oscillates in a potential well with an exponential decrease of energy, and second decision, its energy increases without limit. For the mechanics of a particle with an oscillating charge, there are three possible modes of behavior, which, as it was found out, do not depend on the type of the potential well; it must only be finite and have equal sides.¹³

The resulting modes of the particle’s the behavior under equal conditions greatly depend on the initial phase, and its variations result in a very rich variety of trajectories.¹³

Notice that non–isochronism is essential for the dynamic stochastic systems without dissipation. Indeed the increase or decrease in fluctuation energy due to perturbation is the phase–dependent. The phase, in turn, depends on the frequency changing in disturbed conditions because of the isochronism. As discussed above, the system can get out of a single resonance. With multiple (more than one) resonances, however, the system the behavior pattern is complicated by their interactions. So, depending on the disturbance phase, the system can either proceed to the next resonance region, eventually leaving the well, or turn back. This state is referred to as the “overlapping resonances”.¹²

Since the middle of the last century in QED, the study of the interaction of high–energy particles has made it possible to detect resonances that manifest themselves in the form of peaks on the general monotonic behavior of the cross sections of their interactions. Resonances were interpreted as a consequence of the presence of quantum levels in the particles themselves and identified in SM as newly generated unstable particles. Today, all resonances are classified and described within the framework of the Standard Model up to the Higgs Bosons. But the question arises whether it will be correct to interpret all the resonances only to the particles themselves. Direct experimental determination of the resonance dependence of elementary particle–antiparticle birth, under the influence of frequency ν of external radiation and of relativistic protons in the quantum vacuum (dark matter), is almost completely rejected by modern physics. Following the deceptive logic of the modern theory, this dependence is drawn as a monotonically the increasing curve, which contradicts the experimental discoveries made recently in the LHC and in the near–Earth space. In this case, the polarization of a quantum vacuum in space and vacuum installations under electromagnetic action is accompanied by the production of electron–positron pairs of particles and antiparticles. In the role of exchange particles in the electromagnetic interaction with quantum vacuum in QED are playing the photons. We recall the most popular Feynman’s diagram for the interaction of two electrons.^{13,14} Their trajectory of mutual at rapprochement and repulsion (the latter occurs according to Coulomb’s law) is determined in QED by the interaction of charges, which are exchanged in this case by virtual photons. In our concept, where there is a quantum vacuum structure, the use of the concept of an exchange photon is not necessary, since the process of polarization (deformation) of a vacuum can be represented energetically the formula (1).

For today, one is reliably known the existence of four fundamental interactions (excluding the Higgs field): the gravitational interaction; the electromagnetic interaction; the strong interaction; the weak interaction. Analysis of experimental data associated with the investigation of the anisotropy of physical space allows us to assume the existence of a fifth interaction (of fifth force).¹⁵ Quantum vacuum participates in all fundamental interactions, but if polarization of vacuum in electromagnetic interactions is accompanied by the production of electron–positron pairs with the participation of exchange virtual photons, then in a strong nuclear interaction the polarization of the quantum vacuum is accompanied by the production of three unstable π mesons ($\pi^0, \pi+, \pi-$) with the participation of involving

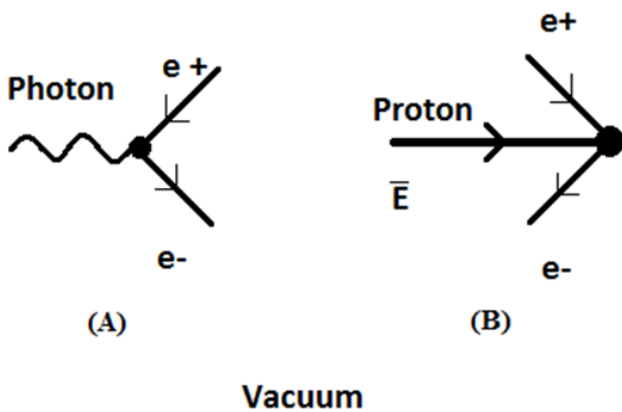


Figure 1 Polarization of quantum vacuum. A) If the vacuum polarization is caused by the motion of photon; B) If the vacuum polarization is caused by the motion of relativistic proton or by the peak electric field strictly oriented in one the direction E.

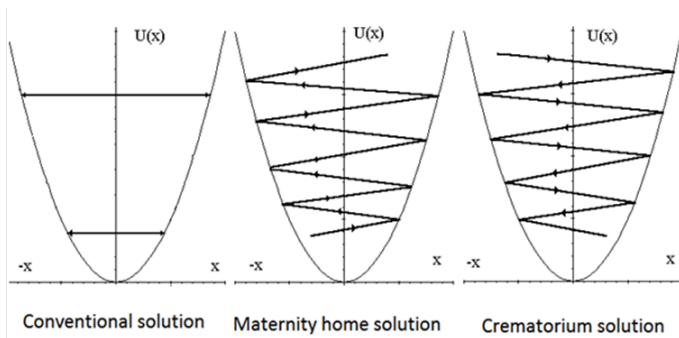


Figure 2 The solution of the harmonic oscillator problem.

The autonomous movement equation the particle in the case of a potential well in the shape of the hyperbolic secant

$$U(x) = -U_0 \operatorname{sech}(x^2) \tag{2}$$

Will look as follows:

$$m \frac{d^2x}{dt^2} + 4U_0 Qx \frac{\cos^2\left(mx \frac{dx}{dt} + \varphi_0\right) \sinh(x^2)}{\cosh^2(x^2)} = 0$$

where m, Q, φ_0 is are mass, charge an initial phase of a particle respectively, x is the coordinate of the particle as a function of time;

exchange virtual points. At the same time, the energy spectrum of the production of new particles and antiparticles changes, which indicates a change in the structure of the quantum vacuum when it enters the atomic nuclei.

Professor A.V. Rykov, relying on his of the theory of quantum vacuum,¹⁶ as early as 2000 obtained the value of the frequency of natural oscillations of the structural element of the cosmic quantum vacuum $\nu_r = 4.6911 \cdot 10^{24} \text{ Hz}$ ($W_r \approx 20 \text{ GeV}$), assuming that in the electromagnetic interaction the dipole structure of the cosmic quantum vacuum will be formed by the virtual electron–positron pairs. According to Rykov, with the size of the structural element of the cosmic medium dipole $r_e = 1.3988 \cdot 10^{-15} \text{ m}$, the ultimate deformation (destruction boundary) $dr_e = 1.0207 \cdot 10^{-17} \text{ m}$ is related by the relation $dr_e = \alpha_e r_e$, where $\alpha_e = 0.0072975$ is the fine structure constant. Destruction boundary corresponds to the external photon energy $W_e \geq 1 \text{ MeV}$ (the initial boundary of the photoelectric effect in the quantum vacuum $W_{phot} = h\nu$). The deformation in physical vacuum is less than dr should be of an electroelastic character, and at higher values, deformation leads to the destruction of the dark matter dipole and to the creation of an electron–positron pair.¹⁶ Assuming that in the nuclear interaction (strong interaction between nucleons) the dipole structure of the nuclear quantum vacuum will be formed by the different virtual pions (π^+ , π^-), Professor A. Rykov calculated the natural frequency the dipole structure of the nuclear quantum vacuum $\nu'_r = 1.6285 \cdot 10^{26} \text{ Hz}$ and the value the energy, necessary for the destruction of the dipole structure and the resonance production of three π^- -mesons (π^0, π^+, π^-) $W'_r \approx 600 \text{ GeV}$. According to Rykov, with the size of the structural element of the dipole of a nuclear quantum vacuum $r_x = 5.1408 \cdot 10^{-18} \text{ m}$ the final deformation (fracture boundary) $dr_x = 1.6356 \cdot 10^{-20} \text{ m}$ is related by the relation $dr_x = \alpha_x r_x$, where $\alpha_x = 0.00318157$ the fine structure of a nuclear quantum vacuum. The fracture boundary corresponds to the energy of an external photon $W_x \geq 30 \text{ GeV}$ (the initial boundary of the photoelectric effect of the production of π^- -mesons in a nuclear quantum vacuum). The analysis of the experimental data at the LHC (2012–2018) does indeed show the presence of resonant peaks in the energy spectra of particle production for pp-collisions energies $W_r \approx 20 \text{ GeV}$ and $W'_r \approx 0.6 \text{ TeV}$. Thus, Professor AV Rykov relying on the analysis of the photoelectric effect, proposed the dipole structure of the quantum vacuum (particle and antiparticle) and was able to predict the resonant frequency (energy) of production of electron–positron pairs and π^- -mesons under the action of cosmic radiation and the relativistic protons (2000), 15 years earlier than similar results were received in experiments conducted at the LHC and the space detector AMS–2 (2015–2018). In this comparison of demonstrates deep analogies, evidencing, at a minimum, the unity of the physical principles of the behavior of matter in a wide range of densities and temperatures. Perhaps the creation of particles in a vacuum is a manifestation of the instability of dark matter. Today, according to the results of the experiments at CERN, many physicists believe that dark matter is connected with the study of the microworld at the smallest distances and of extreme energies.⁶

Experiments

Higgs boson

The discovery in the LHC of heavy Higgs boson resonances (mass 125 GeV), obtained in 2012 with pp collisions at high energies, would seem to confirm the validity the predictions of the Standard Model. The authors of the theoretical works¹⁷ P. Higgs and F. Englert were awarded the Nobel Prize in 2013 for “the theoretical discovery of a mechanism that helps us understand the origin of the masses of subatomic particles and which was recently confirmed by the discovery of a new predicted particle at the Large Hadron Collider.” The situation when theoretical predictions appear before their experimental confirmation and wait for almost half a century of their recognition (the Nobel Prize) is really unique. Everything that is now known about the new particle agrees well with its interpretation of the Higgs boson predicted by the theory of elementary particles within the framework of the simplest version of the SM. Within the framework of the SM, it is possible to calculate both the probability of the Higgs boson production in the pp-collisions in the LHC and thereby its decays, and thereby predict the number of expected events. The estimate of the lifetime of the Higgs boson on the basis of experimental data does not contradict the prediction of the Standard Model and is $T \sim 1.6 \cdot 10^{-22} \text{ s}$. The Higgs boson (H) can decay in many different ways: to photons, to heavy W or Z bosons, to quarks or leptons. What is a boson? Each particle has, as it were, an internal moment of rotation, the spin (this is a quantum mechanical phenomenon). There is a whole and half-integral spin in units of Planck’s constant. Particles with spin 1/2 or 3/2 (any half-integral spin) are called fermions. In bosons, the spin is an integer, which leads to fundamental differences in the properties of these particles; in the Higgs boson, the spin is 0 (and this is an integer). The Higgs boson is electrically neutral. The Higgs boson, in contrast to all other vector bosons, is a scalar particle. It is believed that the Higgs field fills the entire universe. But the question arises: “interacting with the Higgs field, all the particles acquire mass, but the Higgs boson from this universal mechanism falls out! This is far from trivial; this ambiguity is fundamental and fraught with extremely serious consequences for SM.” In this connection, academic RAS V.A. Rubakov in the article “Higgs Boson” asks the question: “Why do we need a new Higgs field?” and he himself answers: “The short answer is that the symmetries of the theory of elementary particles of the Standard Model forbid elementary particles to have the mass, and a new field breaks these symmetries and ensures the existence the masse of particle” and continues: “In the standard model—the simplest version of the theory (but only in it!)—all the properties of the new field and, correspondingly, of the new boson, except for its mass, are unequivocally predicted again on the basis of symmetry considerations”.¹⁸ Thus, the question of the mass of the Higgs boson is generally deduced from the consideration of the SM. Unfortunately, today the standard model does not have a theory capable of calculating the mass of elementary particles, including the mass of the Higgs boson. SM contains from 20 to 60 arbitrary adjustable parameters (there are different versions of SM) for calculating the mass of particles. L.G.Sapogin’s Unitary Quantum Theory (UQT) allows for calculating the mass spectrum of all hitherto known or hypothetical elementary particles up to the Higgs Boson.¹⁹ And also, a solution of

the simple scalar version of UQT basic equation for the wave packet allowed producing a theoretical calculation of the elementary electric charge and the fine structure constant of a particle.¹³ According to L. Sapogin's UQT, the particles as clots (wave packets) of a real field is governed by the structure–function and can be decomposed into flat sinusoidal waves by means of transformations of the Fourier's series. The structure is here represented as a harmonic amplitude/frequency function (spectral representation). The quantum package becomes classical with increased mass and quantization the mass in a delicate balance between dispersion and non–linearity. The particle moves according to classical laws of motion, while each packet is governed by quantum laws. L.Sapogin's Unitary Quantum Theory describes elementary particles as clots (wave packets) of a real–world field to be “identified with the quantum vacuum (dark matter)” and wherein the presence or non–presence of the quantum vacuums (dark matter) here irrelevant. Of course, the UQT admits of energy exchange with the cosmic medium comprising an agglomeration of random oscillations, but not as a prerequisite for energy generation. L.Sapogin explains by unrestricted energy growth in the oscillating particles in a potential well, according to UQT differential equations for an oscillating charge, describing single micro–particles in motion: “The UQT suggests that conservation laws are only applicable over the averaged ensemble of particles and never to single ones. On the other hand, energy generation is governed by the nature of particle motion equations, whether oscillating in the vacuum or in the medium.”¹³ In proposed our, the model of the creation of particles in a quantum vacuum, including the Higgs boson as a result of pp collisions at high energies in the LHC, the mass of the particles is determined by resonances. When the frequency of oscillations arising when a proton moves in a quantum vacuum of the LHC $\omega_B = \frac{mv^2}{\hbar}$ is close to the natural oscillation frequency of the particle $\omega_S = \frac{mc^2}{\hbar}$, generated in the process of polarization of a quantum vacuum (dark matter), resonance occurs. Resonance is accompanied by an increase in the additional mass of the particle:

$$m_r = \hbar \omega_r / c^2 \quad (3)$$

where m_r is mass of a quantum object, ω_r is frequency of the wave function of a quantum object, c is the speed of light $c = 299792458 \text{ m/s}$

$\hbar = h / (2\pi)$, $\hbar = 1,0546 \cdot 10^{-34} \text{ J/Hz}$, h is the Planck's constant,

$$h = 6.6260 \cdot 10^{-34} \text{ J/Hz}.$$

Another mechanism for generating the mass of elementary particles was proposed by the professor Yu.A.Baurov in a new theory of the Byuon (TB).²⁰ The base object for the formation of masses of leptons in TB is object 4B, which arises in the process of minimizing the potential energy of the byuon. The bulk of the potential energy passes into the energy of rotation (spin) of elementary particles. The residual part is treated as a mass of particles. For an electron, the minimum residual potential energy $E = 33eV$. Inside TB, the physical space without particles, from the baryon matter, is a quantum medium formed from byuons 4B having an uncertainty interval of Heisenberg. Smearing of objects 4B in the Universe creates the observed matter density in the Universe of $\rho_V = (0.721 \pm 0.025) \cdot 10^{-29} \text{ g}\cdot\text{cm}^{-3}$ (dark energy and dark matter) and connects all objects of the universe in one information field.²⁰

Based on the results of experiments²¹ related to the formation of a scalar boson (H–boson) and a pair of heavy fermions ($\tau\tau$ –leptons) in colliding electron and positron beams conducted in 2017–2018 at the CEBB–4M collider of the Novosibirsk Budker Institute of Nuclear Physics, Siberian Branch of the RAS, it can be concluded that the monopoly of study the Higgs boson in the LHC in the collision of proton beams has remained in past. The common for all experiments in LHC and CEBB–4M is the presence of a quantum vacuum (dark matter). When are achieved the resonances that occur when colliding the particles ($e-e+$ or pp collisions) in colliders, in of a quantum vacuum, unstable particles are created, including the Higgs boson.

The effect of the stability of relativistic protons with increasing energy of their collision in the Large Hadron Collider (LHC)

The experimental discoveries made recently in the LHC include an increase in the fraction of the processes of elastic scattering of relativistic protons as their collision energy increases, that is, an increase in the proton stability effect. The proton beams collide in the LHC with energies up to 13 TeV in their center of mass system. This energy should exceed the proton's own rest mass by more than four orders of magnitude in magnitude ($m\rho \sim 9380000 \text{ MeV}$). The main goal of research at the collider is to study the forces that control the interaction of particles and clarify their internal structure. Although there are currently no indications of critical deviations from the predictions of the Standard Model (SM), which combines strong and electroweak interactions, a number of experimental facts that need to be explained are observed. This problem is especially evident in the case of strong interactions in the so–called soft hadronic processes. In particular, it is surprising that as the collision energy of relativistic protons increases, the probability of their integrity increases. Such a picture contradicts the notions of classical physics and goes beyond the framework of the SM. The author of the article¹ professor I.V.Dremin concludes that the probability of the survival of two protons with preservation of their integrity, with increasing collision energy, is related to the purely quantum nature of the structure of hadrons with quarks and gluons located inside. They manifest themselves in inelastic processes in the form of newly born ordinary particles and resonances. It is the dynamics of internal fields in the process of elastic collision of protons that should be responsible for the observed increase in the probability of proton survival with increasing energy. The reason for the increase in the probability of proton survival is not yet clear. Undoubtedly, strong correlations should be responsible for this effect.¹ For example, the increased role of elastic scattering can be associated with an increase in the tension of strings connecting quarks with the Lorentz–compression measure. In this case, the emission of soft gluons (an inelastic channel) becomes less probable. Another possible explanation for the increase in the probability of survival of protons may be due to the fact that as the energy increases the density of very soft (wee) gluons increases, and their interaction decreases. Such an effect can be due to the structure of the vacuum of quantum chromodynamics (QCD) and the manifestation of the so–called contact Θ –term in the Lagrangian in QCD.²² The high pressure in collisions of protons and the maximum high density of soft gluons can lead to a decrease in the coupling constant and to their condensation as a function of energy.²³ However, new discoveries make it necessary to reconsider the nature of the resonances and the mechanism for the production of new particles. I think that after Volker Burkert and his colleagues from the Jefferson laboratory found that in the of the

proton the pressure could exceed 10^{35} Pascal,²⁴ it would be naive to assume that the maximum energy of the colliding beams of protons achievable in the LHC would be enough to destroy proton. It can be assumed that the creation of particles in this energy range is associated with resonant phenomena in the quantum vacuum (dark matter) and are irrelevant to the integrity of the protons, that is, all collisions the protons in the LHC, except resonances, are elastic. Volker Burkert conducted a series of experiments on the accelerator CEBAF. After the collision of fast electrons with a mass of liquid hydrogen (a source of protons), the researchers registered the particles arising as a result of their interaction—an electron, a proton, and two photons. The researchers observed the scattering of photons, comparing their characteristics with information about the proton and the accelerated electron. This scattering gave the scientists a scheme of energies and pulses that made it possible to describe the extreme pressure at the center of the proton. Until recently, it was believed that using such an important relationship as the unitarity condition (the assertion that the total probability of all elastic and inelastic processes in the collision of protons should be equal to unity) makes it possible to elucidate the spatial picture of the region of the proton interaction and its evolution with energy change.²⁵ However, the results of the latest experiments obtained in the LHC, when the proton collision energy reaches 13 TeV, allow one to doubt the reliability of the unitarity condition, in which two channels of elastic and inelastic collisions of protons are rigidly related to each other by a probability of events.¹ Recognition of the polarization of quantum vacuum (dark matter) under the action of ultra-relativistic protons and super-powerful magnetic and electric fields leads to the creation of jets of unstable particles in LHC and distorts the spatial picture of the proton interaction region adopted in SM, that is, the third channel adds.

Conclusion

Thus in the light of the analysis of new experimental data, the Standard Model (SM) should be revised and the simple minimal expansion of the SM called SMASH, proposed by Dr. G. Ballesteros of the University of Paris–Saclay France, is clearly not enough.²⁶ G. Ballesteros adds to the particles SM three right neutrinos, two Weyl fermions (i.e., their properties are described by Weyl's theory) and a scalar field σ , and its vacuum average 10^{11} GeV represents a new energy scale. At low energies, the new model reduces to an SM, supplemented by the seesaw-mechanism of neutrino mass generation and the aksiony with the mass of $50-200 \mu eV$, which can be particles of dark matter and at high energies, the new model operates up to the Planck scale of energy.²³ However, the new model cannot explain the nature of the dark energy of the universe. The Leo Sapogin's Unitary Quantum Theory (UQT)¹³ and the Yuri Baurov's Theory of the Byuon (TB)²⁰ substantially supplements SM. Non-baryonic matter, which forms the basis of the intergalactic medium, is in constant force interaction with the baryonic substance of planets and stars that are born from it. This non-baryonic matter is the main source of energy for the formation in them not only of electron-positron pairs but also of any other structural elements of matter. Moreover, possessing an all-pervasive character, this medium influences all processes occurring in accelerators and colliders. It may turn out that the number of resonances identified as the newly generated unstable particles at the polarization of a quantum vacuum, under the action of peak electric and magnetic fields or relativistic protons in the LHC is so great that it will be necessary to create special tables analogous

to the tables published by the collaboration Particle Data Group (PDG), which describes all the properties of resonances associated with the presence of quantum levels in the particles themselves. The addition new particles in SM to the Higgs boson review may include the X boson. Jonathan Feng, the professor of physics & astronomy at the University of California, Irvine, in a press release in 2017 said: "For decades, we've known of four fundamental forces: gravitation, electromagnetism, and the strong and weak nuclear forces. Discovery of a possible fifth force would completely change our understanding of the universe, with consequences for the unification of forces and dark matter. Dispensing with the dark photon, the physicists posit a "photophobic X boson." Other known forces before it only acted on electrons and protons. This new force interacts with electrons and neutrons at a very limited range. Scientists say there is no other boson possessing the same characteristics—hence the name X boson". The X boson of dark matter makes it possible to explain a number of experiments in which the anomalous magnetic moment of the muon is observed. It should be noted that the discovery of phenomenon the polarization of quantum vacuum (dark matter) in theories of quantum electrodynamics (QED) and quantum chromodynamics (QCD) leads to violating the symmetries, conservation laws and prohibitions in the Standard Model. The each symmetry in SM has its own conservation law. For example, the symmetry with respect to time shifts corresponds to the law of conservation of energy, symmetry with respect to shifts in the space—the law of conservation of momentum, and symmetries with respect to rotations in space (all directions in space are equivalent) corresponds the conservation of angular momentum. Conservation laws can be interpreted as prohibitions: symmetries prohibit the change of energy, momentum and angular momentum to the closed system during its evolution. The participation of the quantum vacuum (dark matter) in all interactions causes the rejection of the paradigm of a closed system of evolution and requires revision of all conservation laws and of symmetries. Today, experts working at the Large Hadron Collider, they are asking themselves about the epochal paradigm substitution in physics. An example is the article by Joseph Likken and Maria Spiropul: "Supersymmetry and Crisis in Physics".²⁷ There is a question: "What should be the new physics?" There is no unity on this issue among the physicists. This article is a the forerunner of the emergence of a new physics in which violation of conservation laws in the open systems is allowed, the prohibition on the creation of devices with an efficiency of more than 100% is lifted and in which for the mankind opens up and the inexhaustible source of conceptual innovations in the all fields of activity.²⁸

Today, before the physicists there is of question: "Which project them choose for the new collider?" If the LHC had discovered the new particle outside the Standard Model or reliably pointed some fundamentally new effect, of physicists would know how to build a collider to study this phenomenon. This would be a reasonable of choice. Now of physicists are forced to make a choice almost blindly, trying to find an option that would be optimal in terms of time, financial investments, and the expected scientific impact. In September 2017, at the 186th session of the CERN Council, the secretariat of the European Strategic Group (ESG) was established, a new body to coordinate the preparation of the updated European Strategy. The key task of the European Strategic Group is to draw up a final program plan and submit it for consideration at CERN. I propose to the European Strategic Group consider this article, for research a fundamentally new the effect—the polarization of quantum vacuum (dark matter) in the new collider. In the list of tasks for the

new collider, it is necessary also to include an investigation of the fifth fundamental interaction on the basis the Yu. Baurov's Byuon theory and on the based the professor Jonathan Feng's theory "photophobic X boson" and the study of elementary particles based on the professor Leo Sapogin's Unitary Quantum Theory. Then can really talk about the new physics otherwise "many countries will continue wasting their time and money in empty projects like the International Thermonuclear Experimental Reactor (ITER), the Large Hadron Collider (LHC) and the like".^{29,30}

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Conflict of interest

Author declares there is no conflict of interest.

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